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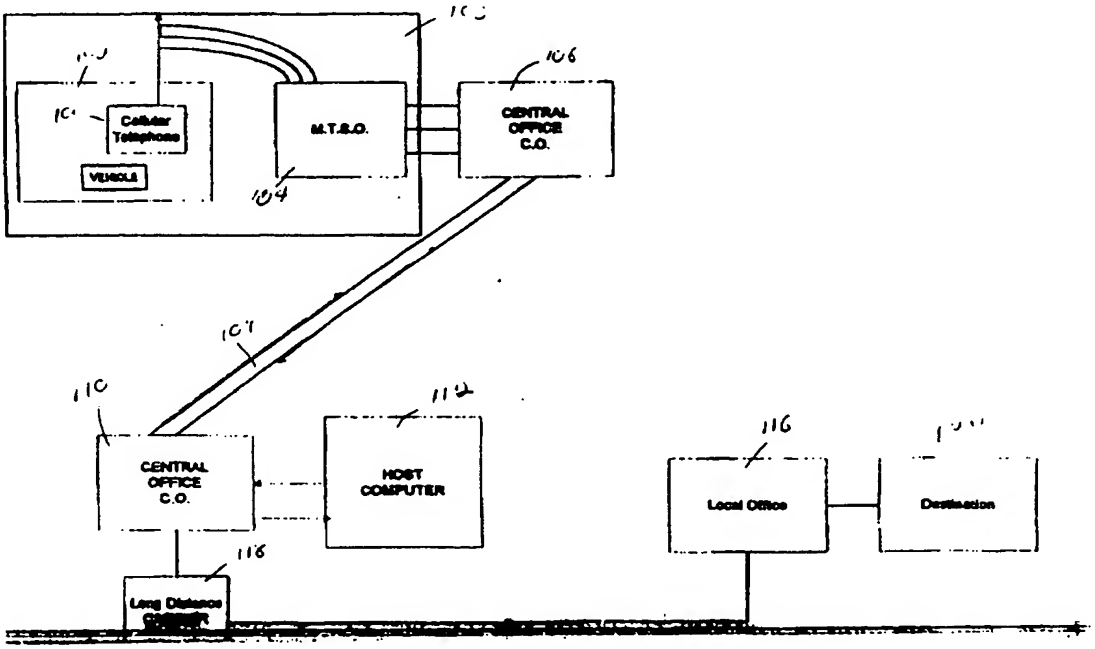

(57) Abstract

A credit card based cellular telephone billing system which enables billing independent of either the mobile telephone switching office (104) or local telephone switches (116). Billing is carried out at a central location (112). All calls are routed to that central location (112).

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CELLULAR TELEPHONE CREDIT CARD BILLING SYSTEM

Field of the Invention

The present invention describes a cellular telephone system which uses credit card billing, in which billing is carried out independent of the cellular carrier.

Background and Summary of the Invention

Cellular telephone has relieved the telephone system's dependence on wires for communication by their installation in mobile platforms. Cellular telephones have typically been associated with a single billed party. Cellular pay phones have been used in the past in only very limited circumstances.

One of the first wireless payphones was fully developed by GTE. GTE has furthered this concept with the GTE credit card-activated cellular phone which is manufactured by OKI Telecom of Tokyo, Japan. Various other technologies have built on the basic GTE system.

A major problem in all existing cellular pay phones is the monitoring and transfer of billing data. A cellular telephone call includes two parts: the cellular part, which is the wireless connection between the cellular telephone and the cellular telephone provider equipment ("the mobile telephone switch office" or MTSO), and the land line part which is the standard connection between the MTSO and the called party.

The cellular telephone system uses a number of paging and overhead signalling messages to allow continuous transfer of data between the mobile telephone and the mobile telephone switch office. The MTSO therefore always knows the position of the cellular telephone, whether or not it is engaged in a call, and the destination of a call. The cellular network can easily track the billing because it monitors the called party, the calling party, and length of time of the call. The prior art has therefore used the cellular network to handle billing of all cellular charges.

The U.S. AMPS standard requires each cellular telephone unit to send and receive packets of data, bundled as data words, to the mobile telephone switch office. These data words are labelled A, B, C, D, E, F and G. Each word in the string includes recognition data including the electronic serial number ("ESN") of the mobile unit, and the mobile telephone number and the system I.D. Some of these data words, including the words E and F are unused, and are intended for future developments.

U.S. Patent No. 4,777,646 suggests using these E and F words to carry billing information for a credit card-operated cellular telephone. In operation, the mobile telephone network must decode the E and F information, and obtain the billing information, such as credit card number and call destination, therefrom.

A similar system is currently in use by GTE which uses DTMF tones and modem protocols to shift and transfer data from the mobile unit to a billing computer located at the mobile telephone switching office. This necessitates, however, making an arrangement with the owner of the mobile telephone switching office. This causes a problem when a first company wants to set up a cellular telephone billing system of this type, but the MTSO is owned by a competitor of that first company.

Another problem with this system is that it is not clear whether all versions of the cellular network will recognize the E and F words. It is clear, however, that the newer digital systems, such as ISDN, TDMA, SMR and the other systems under implementation will not recognize the E and F words. The inventor of the present invention recognized that a system which performs billing independent of the cellular switch is necessary.

Another problem is that this system simply stores the credit card billing information as received in the computer, and periodically, e.g., nightly or in actual practice weekly or monthly, transmits the information to the bank. There is no real-time verification of the credit card numbers used, and the billing information may not arrive at the bank until as long as a month later. This problem is exacerbated by the last phone call problem. This system requires the cellular telephone unit initiating the call to keep track of how long the

call has continued. The system does not know how long the call has lasted, however, until the end of the call. At that time, the transmission is over, and so the length of time of the telephone call is maintained in a memory of the cellular telephone. This information is downloaded at the beginning of the next telephone call. This means that the completion information is sent only much later than the actual call. If the telephone is infrequently used, the completion information, and hence the billing, may be completed only very much later than the actual call completion.

While a one-time per day or week etc processing of bank records was feasible in 1980, the increasing proliferation of credit and credit card fraud has caused banks to require that charge transactions be processed at the time the actual transaction occurs, not hours or a day or two later. This produces another specific problem with a credit card operated telephone. Specifically, actual credit card approval can take many seconds to carry out. In earlier systems, credit approval was carried out over the cellular network, and took very long to effect. This has two problems: it lowers the carrier's profit margin, but also, it provides frustration to the user; waits as long as 50 seconds before credit approval is obtained are not uncommon. Such waits make using such a telephone extremely frustrating.

The inventor of the present invention noticed these problems, and solved them by defining a credit-card activated cellular telephone which has its billing characteristics independent of the setup at the cellular carrier or the setup at the local telephone office. It is easily installed in any platform location, and does not require any special cooperation from any cellular carrier. The system operates quickly and efficiently and produces virtually real-time billing and requires no billing information from the cellular carrier.

Examples of platforms in which this system could be installed include limousines, trains, taxis, boats, airplanes, automobiles including rental automobiles, electric golf carts and the like.

Previous attempts to outfit such platforms with cellular credit card-driven devices have met with substantial frustration. The inventor of the present invention found that one main problem involves the dependence of existing systems with the cellular switch and cellular carrier. The present invention obviates this dependence.

Different carriers handled different parts of the country. It was necessary to obtain an agreement with each carrier in the part of the country that the operation was to occur. This is, practically speaking, impossible, because, inevitably, the party doing the

cellular operation was a competitor of at least one of the local companies.

Previous systems did not allow real time production of the bills. This also caused problems with collection of the credit card amounts. It is easy to accumulate enormous bills from cellular telephone usage. The old systems, in which the information would be collected only days or weeks later made it more difficult to actually collect the credit card amounts from the user. The present invention allows monitoring this information in substantially real time.

Brief Description of the Drawings

These and other aspects of the invention will now be described in detail with reference to the accompanying drawings, wherein:

Figure 1 shows a diagram of the overall communications scheme used according to the present invention;

Figure 2 shows a basic block diagram of the cellular telephone used according to the present invention;

Figure 2A shows a more detailed block diagram of the cellular telephone of the present invention;

Figure 3 shows a flowchart which is executed by the microprocessor of the present invention according to a first aspect thereof;

Figure 3A shows a flowchart of processes executed by both the microprocessor of the cellular telephone and the processing unit in the host computer according to a second embodiment of the invention;

Figure 4 shows a block diagram of the central processing office host computer;

Figure 5 shows a flowchart of a second embodiment of operation of the host computer;

Figure 6 shows a flowchart of a process executed by the processor according to another embodiment of the present invention; and

Figure 7 shows a block diagram of a telephone line interface unit used in the host computer of the present invention.

Figure 1A shows a front view of the modified cellular telephone according to the present invention;

Figure 2B shows a side view of this cellular telephone;

Figure 3B shows a bottom view of the cellular telephone;

Figure 4A shows an assembly view showing the unmodified cellular telephone connected to the interface assembly;

Figure 5A shows the battery as disconnected from the interface assembly;

Figure 6A shows the interface assembly;

Figure 7A shows a cross section of the interface assembly along the line 6-6 in Figure 6A;

Figure 8 shows the interface assembly;

Figure 9 shows a cross section along the line 9-9 in Figure 8;

Figure 10 shows a contact assembly used on the interface assembly of the present invention;

Figure 11 shows a cross section across the line 11-11 in Figure 10;

Figure 12 shows a cross section along the line 12-12-12 in Figure 10.

Description of the Preferred Embodiments

A block diagram of the overall communication scheme used according to the present invention is found in Figure 1. The present scheme uses a system whereby a cellular telephone 100 installed in any platform 102, virtually anywhere in the world, can operate independent of the carrier's computer.

The credit card operated telephone 100 is installed in platform 102, which as described above, could be an automobile, train, taxi, boat, airplane, electric golf cart, hired car or the like. This telephone operates in the normal cellular way according to the cellular network processes as described, for example, in U.S. Patent No. 3,906,166, the disclosure of

which is incorporated by reference herein. The telephone 100 communicates with the mobile telephone switching office 104 servicing its current cell 103. MTSO 104 is operated by whatever cellular provider services telephone 100, and treats the communications from telephone 100 just like any other cellular message. MTSO 104 passes requests for calls to local switching office 106 and also receives incoming calls therefrom. CO 106 is the central hub office of the MTSO 104. Local office 106 is generally run by the local telephone company handling telephone traffic for the area of the cell 103.

According to the present invention, all calls initiated from telephone 100 are placed to host computer 112, which also has a central switching office shown as office 110. Local office 106 connects to local office 110 over telephone trunk 109 in the conventional way.

According to the present embodiment, telephones 100 input credit card billing information as well as a destination telephone number from the user. Telephone 100, however, does not call the destination telephone number, but rather automatically dials a pre-programmed telephone number, e.g. an 800 number, which connects it to host computer 112.

Therefore, according to the present invention, the initiated telephone calls from every location are connected first to host computer 112.

Host computer 112 decodes the information indicating the telephone number to be called, and places an outgoing telephone call on line 114 to the destination 120, which is the destination indicated by the telephone number that the caller has entered. This means, however, that the call is actually relayed back to central office 110 which places the call to destination local office 116 which then connects with destination 120.

The connection must now be maintained. According to a first embodiment of the invention, central office 110 provides a "CENTREX" type system to the facility of host computer 112. The CENTREX system allows the local office 110 to carry out the functions of a PBX switch, including call forwarding and three way calling. The host computer 112 of this embodiment controls a three-way call between the incoming call and destination 120. This frees the host computer to do other work, but necessitates that one line be installed into the host computer premises for each call which is being handled. It also means, however, that host computer has complete real time monitoring capabilities for the call. Host computer 112 stores information indicating the location of destination 120, and from this can obtain the cost per minute for the long distance part of the call. It also knows the time duration of the call since one line of the computer remains on the line. From this it can calculate

the cellular charges which will be incurred by the cellular provider.

According to a second embodiment of the invention, the system uses a digital operation: preferably the "primary rate interface" service of the ISDN system. This allows the host computer to control the switching system within the central office 110 sufficiently to enable central office 110 to completely control the call, and host computer 112 to leave the line. Having left the line, however, host computer 112 can no longer carry out real-time telephone call monitoring. It should be understood that the digital system used could be GSM 900, TDMA, SMR or other similar digital technologies as an alternative to ISDN.

Host computer 112 has initiated the call, and therefore knows the beginning time of the call. Since the host computer leaves the call in this embodiment, however, the ending time of each telephone call is not known by host computer 112. Accordingly, according to this second embodiment, host computer 112 polls the long distance carrier 118 every ten minutes in order to obtain billing information about the duration of long distance calls. This duration information is used to calculate both long distance charges, and cellular charges.

According to another aspect of the invention, useable, but less preferred, with both the first and the second embodiments, the telephone 100 stores the ending

time of the last call in its memory, and transmits this as part of the next call. This provides another check from which host computer can determine billing information. This system can be used for tracking local calls, for which the long distance carrier 118 does not have billing information. A basic block diagram of the telephone electronics of the telephone of the present invention is shown in Figure 2. The system is preferably a modified existing cellular telephone unit, modified to carry out additional functions. The block diagram shows the conventional telephone electronics generically as block 200. It should be understood that this includes the circuitry for carrying out all communications necessary according to the AMPS, TACS, TDMA, SMR and other cellular telephone standards.

Additional circuitry carries out the other functions necessary according to the present invention. Microprocessor 202 controls much of this additional operation. Memory 204 includes a number of embedded memories including a credit card database memory 206, and a message memory 208. Message memory 208 assembles the data message which is sent to the host computer 112 to begin the operation. Number crunching and data communications is controlled by a digital signal processor chip 210 which is preferably a Phillips chip number UMA 1000.

A more detailed block diagram is shown in Figure 2A. The cellular telephone interface module 220 includes a number of connected structures. The credit card information is input through card reader 222 to reader interface 224 which collectively form the credit card swipe device 212. Readers and reader interfaces of this type are conventionally available in the art. The output of reader interface 224 is provided to microprocessor 202. The data processor 209 includes associated circuitry for encryption here shown as clipper chip 226. Any other data encryption mechanism and decryption mechanism could alternately be used. The DTMF transceiver 228 provides the dialing capability through quad switch 230 to the telephone handset 232. In this embodiment, the memory 204 is an E^2PROM

The microprocessor also drives a speech synthesizer 234 through an A/D converter 236. Speech synthesizer 234 produces spoken speech through speaker 238. Messages can also be provided to the user on a liquid crystal display 240, driven by an LCD display driver 242.

The microprocessor controls the Figure 2 and Figure 2A structure according to the flowchart of Figure 3. At step 300, the microprocessor receives the credit card number from reader interface 224 of credit card swipe device 212. This credit card number is temporarily stored in the message memory 208. At step 302, the

credit card number is compared with database 206 of expired, invalid and stolen credit cards which is stored in E^2PROM 204. This database is periodically updated. Step 302 also compares the expiration date for the credit card with the current date from real time clock 214.

If either test fails, control passes to step 304 which produces an error message to the LCD display. If the credit card matches any data in the data base, the LCD display displays "card error" at step 306. If the expiration date test has failed, the LCD display displays "card expired" at step 308.

If, however, the card is found to be valid, the card data is captured at step 310 followed by control passing to step 312 where dialing is enabled by production of a dial tone by the conventional telephone electronics 200.

At this time, the user enters the destination telephone number, which is stored in message memory 208. Step 314 counts digits and determines if the message is completed. If the first digit is a "1", the call is a long distance call, and therefore that ten more digits will follow. If the first digit is other than a 1 or 0, then the call is a local call and only a total of seven digits will be entered. This may differ in some areas, such as Washington, D.C., where area codes are necessary even without 1 prefixes. If the first three digits are 011, then the system waits ten seconds after the last

digit before concluding that dialing is completed. Otherwise, the instant that the last digit is entered, the dialing is complete.

The microprocessor then immediately calls the host computer using a prestored number, e.g. an 800 number or a local access number. Upon connecting with the host computer 112, microprocessor 202 encrypts and transmits the message stored in message memory 208, which includes the last end time of the previous call, the current credit card number, the start time of the current call, and the desired telephone number at step 316.

According to the present invention, the credit card number is compared with the contents of the database at steps 302, 304. This comparison takes less than a second. An approval is not obtained for the specified credit card number, and this system instead takes advantage of the so called "floor limit" which is used by credit card systems.

The credit card companies have a floor limit, which is an amount below which credit card transactions will be accepted independent of an authorization. The floor limit is usually $45-50. A $20 charge, for example, will be accepted without an authorization code so long as the card is not stolen, lost or otherwise bad. Accordingly, the present invention takes advantage of this floor limit.

Many cellular telephone calls may last long enough to exceed the $50 charge. However, users of cellular telephones are accustomed to the problems in the cellular network. Some areas in cells have unclear communications, and many times a telephone call is dropped unintentionally as it passes through a cell. According to the present invention, therefore, microprocessor 202 calculates a current charge at step 318. When that current charge is detected at step 320 to exceed $50 (or some other floor limit) the call is dropped at step 322. The user then needs to call back, but this new call forms a separate transaction which will have its own new floor limit.

In this first embodiment, therefore, all unexpired non-stolen cards are assigned a $50 window. The caller does not wait for any credit card processing delays, but instead this system takes advantage of the floor limit.

A second embodiment of the invention, which uses more conventional techniques, is shown in Figure 3A, with the same steps being indicated by the same reference numbers. Step 300 is the card sliding technique, followed by step 330 which is an internal validation of the number. This internal validation is only a checksum and a determination of card expiration date. The same message displays are produced at steps 306 and 308.

If the credit card is valid, credit card data is captured at step 310.

At step 332, the system automatically dials the telephone number of the host computer. A busy signal at step 334 causes a redial at step 336. Upon making a connection, all of the credit card data is immediately downloaded to the host computer at step 338. A check sum at step 340 causes a resend at step 342 if the information is not correct.

Upon receiving valid information, the host computer provides an indication to the telephone electronics to produce a dial tone at step 344. An indication is also produced at step 346 on the LCD display indicating "dial now". While the user is dialing, however, the host computer produces a message to the processing bank including the credit card number and an amount of an exemplary cellular telephone call, e.g. $50-$100. Simultaneously, the host computer is receiving DTMF tones at step 350 indicative of the telephone number to be dialed. However, no dialing occurs in this embodiment until authorization is received from the processing bank at step 352. If there is no authorization, a message is sent to the LCD display at step 354 indicating "card declined", following by a command for hang-up at step 356. If there is authorization, however, the LCD displays the message "approved" at step 358. At this time, the caller is placed on hold at step 360, and the host computer finds an unused telephone line at step 362. At step 364, the

host computer dials the customer's number, followed by a redial, if busy, at step 366, or a hang-up at step 368 if the line is busy for too long. At step 370 a message is sent indicating that the line is busy. However, if the line is not busy, then the call is connected at step 372.

The host computer stores a certain amount of information for each call in its associated memory 410. At step 374, the host computer reads the time and date and stores the appropriate data. The host computer then becomes inactive, and waits for the call to be detected as complete at step 376. Host computer then reads the current time at step 378 and stores data indicative thereof. At step 380, the host computer calculates call charges, and sends a message to the telephone at step 382 indicating that the current call charges are X. The host computer may then send another message such as Thank you at step 384, followed by a hang up at step 386.

The host computer then again accesses the processing bank at step 388, and requests payment from the card user. The record is stored to an internal processing unit of the host computer at step 390.

A block diagram of the electronics of the host computer is shown in Figure 4. A flowchart of the communication carried out by the computer is shown in Figure 5.

The host computer includes a plurality of line interface cards 400, each of which receives information from a telephone line 402. The line interface card provides certain handshaking with the call to be sure that the incoming call is actually an authorized call.

According to the preferred mode of the present invention, the line interface card answers with a special tone, e.g. 400 hertz, which is received by telephone 100 as a request to send handshaking data. The telephone responds by sending the message that is currently in its message memory. According to the preferred mode of the present invention, the message in this memory is encrypted using the clipper chip (TM). An alternative preferred mode, however, encrypts the message using public key encryption, using a program such as Pretty Good Privacy (TM) available from various sources. Public key encryption has many advantages. First, public key encryption is well-established, and is virtually unbreakable. Public key encryption prevents anyone from reading the confidential information in the message, which includes the credit card number. It also has an additional advantage of uniquely identifying the sender of the information.

Security is very important in this system, since according to at least one aspect, the credit card number on the message has already been verified by the telephone electronics. Also, since the host computer acts on this

message by placing a telephone call to the number listed in the destination, unauthorized access to this computer can allow a user to surreptitiously obtain free telephone calls.

The I.D. number in the message memory 208 uniquely identifies the telephone from which the calls have originated, e.g. it lists the telephone's ESN. Various parts of public key encryption (a description of which is found, for example, in U.S. Patent No. 4,405,829, the disclosure of which is herewith incorporated by reference), also provides information from which the user can be unambiguously identified.

At step 502, the host computer receives the message from the telephone and decrypts it. Step 504 authenticates the message from the encryption and/or from the ESN of the calling telephone. If authentication is unsuccessful, the process is stopped at step 506, although it should be understood that additional operations could be carried out to trace the unauthorized communication. If the communication is determined as authentic in step 504, however, the message is stored in a memory at step 510 and the actual phone number is called at step 512.

As step 514, the system patches the incoming call to the destination phone number. The patching is carried out in two different ways according to two different embodiments of the present invention.

Figure 6 shows the patch carried out according to the centrex embodiment of the present invention. Centrex is a system which uses the local switching office 110 as a PBX. The user communicates via DTMF pulses with the local switching office to control its operation. The patch according to this embodiment includes the steps of controlling the local office to call the destination on a separate line from the incoming line at step 600. At step 602, the call in progress is turned into a three-way call between the incoming line, the host computer, and the destination. The three-way call operation is controlled by the local office. The carrier is monitored at step 604 once the three-way call has been started. Step 606 determines if the carrier is completed, and if so indicates that the current line can be dropped. This also sets the current time in memory 410 as the end time for the call.

At step 610, the call duration is calculated, and the cost is also calculated. The cost may be calculated according to the usual grids of cost, but more preferably, all long distance calls are charged at a flat rate per minute. At step 614, the charge information is transferred to the bank, and also to a non-volatile memory such as a tape drive or a write once read many (WORM) media.

The digital embodiment uses the primary rate interface of the ISDN network to carry out the call

forwarding. This uses a similar flowchart to that described above.

Figure 7 shows a hardware block diagram of the telephone line interface 400 in the host computer. A plurality of lines 702 are input into a line buffer 704 which buffers these lines and provides them to an optical isolation unit 706. Each of the lines is connected to control logic assembly 710 which includes at least an MPU and a switching device. The switching device controls the switching between each input line 712 and a particular output line 714. It should be understood that any input line 712, 713 can be connected to any output line 714, 715. The output lines are also optically isolated and output through line buffer 704.

The system also includes a voltage regulator 720, an RS232 interface 722 through which the MPU is controlled.

Although only a few embodiments have been described in detail above, those having ordinary skill in the art will certainly understand that many modifications are possible in the preferred embodiment without departing from the teachings thereof.

All such modifications are intended to be encompassed within the following claims.

As described herein, the presently preferred embodiment modifies an existing cellular phone by adding an interface assembly thereto to form a credit-card based

cellular telephone. This interface assembly only incrementally increases the size of the cellular phone, but enables additional functions to be carried out, and also enables a credit card or debit card reading operation. While the description given herein describes credit card reading by a magnetic reader, it should be understood that debit cards, ATM cards, holographic image-retaining cards, and other similar readings could be carried out by the reader, which could be magnetic, optical, or any other type of reader. All of these aspects are intended to be included herein.

The modified cellular phone is shown in Figures 1A, 2B and 3B. The original phone on which the preferred embodiment is based is an OKI phone made by OKI Electronics. Any similar telephone could, however, be modified in a similar way. Basic parts of the telephone include the telephone receiver 110, the telephone transmitter 112 and keypad 114 on front surface 200. Antenna 116 transmits the cellular information. The cellular phone operates using power from battery 120 attached to rear surface 202, or from power supplied through a connector 124. In the unmodified telephone, the battery 120 is connected directly to the rear surface 202 of telephone body 100. The modified telephone has a connection from battery 120 to interface assembly 130, which connects to the rear surface 202 of telephone body 100.

The interface assembly 130 also includes a card sliding slot assembly 132 adjacent a first side surface 206, through which a credit card can be slid. The credit card is slid in a direction such that the credit card's information-containing stripe, preferably a magnetic stripe, comes into contact with a card reader head 134. The slot is formed with inside surfaces 136 and 138 between which the card stripe can be slid. A bottom surface 140 delineates the precise location of the card, which places the magnetic stripe into the proper registration contact with the reading head 134.

The surfaces 136 and 138 include tapered distal portions at both top and bottom ends 142 and 144 which increases a distance between the surfaces 136 and 138. These tapered locations allow the card to be more easily positioned into the slot.

The battery is held onto the interface assembly 130 with a clip assembly 150. The battery 120 is the same battery which was used in the original telephone, and the original telephone also includes a clip assembly 152 therein. However, this clip assembly 152 is not used, and instead a duplicate clip assembly 150 holds the battery 120 into place.

The electrical operation of the credit card-operated telephone is somewhat different than the operation of the usual telephone. The usual telephone bills all calls directly to the owner of the telephone.

By simply operating the telephone, the cellular system can determine to whom the call should be billed. The credit card telephone system requires a modification to the basic system to enable billing. In the system described in application No. 08/291,036, the disclosure of which is herewith incorporated by reference, the interface circuit card controls the basic operation of the telephone in a different way. In this modification, the telephone is reprogrammed to call a processing center which processes the credit card information, and then forward the call to the final receiver.

Another system processes credit card information within an interface circuit card, and enables a call to be sent or received only once the credit card information is received. A memory could then be periodically polled. The specific electrical layout and functioning of this circuit card is not relevant for purposes of the present invention, it being sufficient to understand that additional circuitry must be added to that circuitry already present in the cellular telephone.

In all cases, the information on the credit card must meet a predetermined condition (e.g., credit approval) before the cellular call will be enabled.

A connection diagram between the unmodified phone 400, and the interface assembly 130 is shown in Figure 4A. In the unmodified telephone, the battery 120, shown in Figure 5A, connects directly to connectors 410. A

clip 152 holds the top end 500 of battery 120 into place, and maintains the electrical connection therebetween. The bottom end 502 of the battery 120 is received in a groove 412 formed in the phone to connect the other end of the battery 120 into place. The interface assembly 130 is formed of a planar sheet of plastic, connected to the card reader slot 132, shown in more detail in Figures 6A, 7A, 8 and 9.

Figure 6A shows a rear view of the interface assembly 130: the view seen from the battery side of the telephone. A duplicate connector 600 is located so as to protrude from a rear surface 601 of the telephone. Connector 600 includes prongs 602 located in a similar orientation to those of connector 410, and connecting with the connector points 504 on the battery 120. The rear surface 601 also includes the duplicate clip 150, and a slot assembly 412, which hold the respective ends of the battery 120 into place. The rear surface 601 of this interface assembly as shown in Figure 6A is therefore substantially mechanically the same as the rear side 420 of the unmodified phone as shown in Figure 4A. The surface 601 and front surface 603 are substantially parallel to one another but the slot extends above the front surface 603 in a plane perpendicular to the parallel surface.

The interface assembly is also arranged to form the slot 132 with its opening on the front surface shown

in Figure 8. The front surface as shown in Figure 8 also shows the slot and the circuit board assembly 802 with its reader head 134. The circuit board assembly includes a circuit area 804 thereon including both active and passive circuitry and preferably at least one microprocessor programmed to carry out specific functions. The power for the circuitry is received from the connector 600 via the existing battery 120.

Figure 9 shows a cross section of the device along the line 9-9, showing the plastic surfaces forming the elements. The circuit board 802 and reading head 134 are shown integrated in this relatively thin package.

Figure 4A shows the interface assembly 130 as preferably connected by wires 422 to the existing telephone. Locations on the circuit board 802 are wire connected via wires such as 422 to various connectors. These points on the circuit board carry the power from the battery 120 connected to connector 600, to the existing cellular phone circuitry. The magnetic reader 134 is also connected via connections 424 to appropriate locations 426 on the existing circuit board.

The connection between the devices is established by first preparing a wire connection such as 422, and then screwing the interface assembly 130 into the body of the existing phone, from the bottom surface 602 of the interface assembly, into the rear face 420 of the existing cellular telephone. This mounts the interface

board into precise registration with the body of the cellular telephone.

One advantage of the present system is the small width increase which it adds to the cellular telephone. A certain amount of width is necessary for the card reader to operate properly. However, according to the present invention, the card reader is formed bordering a side surface of the existing cellular telephone. See, for example, Figure 3B which shows that the existing body of the cellular phone 100 accommodates a majority of the width of the card reader slot 132. The interface assembly thickness is limited only by the thickness of the circuit board 802 and the necessary thickness of the plastic 700 forming the interface assembly. This can be done with as little as 3/8 of an inch addition to the thickness of the overall cellular telephone.

One important feature of the present invention is its cloning of the existing battery clips and contact to enable the existing cellular phone parts to be reused. The existing cellular phone battery is attached, without any modification to the battery, onto the interface assembly. Since the same electrical configurations and mechanical layouts are used, this provides a very convenient mechanism of re-using these parts in a modified cellular telephone.

Detailed drawings of the connectors 410 and 600 are shown in Figures 10-12. Figure 10 shows a top view

of this connector, with Figures 11 and 12 showing cross sections along the lines 11-11 and 12-12 respectively. These connectors include contacts 602 which protrude above a top surface 1100 of the connector assembly. The contacts also include solder-down locations such as 1000, enabling them to be soldered to a circuit board. By using the same connector on the interface circuit board which is already provided on the telephone, the battery fits thereon without modification. Clips 150 and slots 412 also allow the battery to mechanically fit on the interface board. Also importantly, since the interface assembly allows the credit card slide slot to be located adjacent the existing cellular phone, it modifies that existing cellular phone with only a minimal amount of thickness changes.

Although only a few embodiments have been described in detail above, those having ordinary skill in the art will certainly understand that many modifications are possible in the preferred embodiment without departing from the teachings thereof.

All such modifications are intended to be encompassed within the following claims.

What is claimed is:

1. A method of establishing a cellular telephone connection between a calling cellular telephone and a destination remote premises, comprising:

entering a destination telephone number representing a telephone number of the destination remote premises into the calling cellular telephone;

controlling the calling cellular telephone to dial a central number, different than said destination telephone number, and to establish a communications connection with said central number;

transferring said destination telephone number to a receiver at a premises of said central number; and

establishing a telephone connection between the premises of said central number and said destination telephone number and establishing a connection between said calling cellular telephone and said destination number via said premises of said central number.

2. A method as in claim 1 wherein said premises forms a three-way call including the cellular telephone and the destination telephone number.

3. A method as in claim 1 wherein said premises controls a digital switching office to directly connect said cellular telephone to said destination telephone.

4. A method as in claim 1 comprising the further step of entering credit card billing information into said cellular telephone, and transferring said credit card billing information to said central telephone premises.

5. A method as in claim 1 comprising the further step of encrypting information transmitted from the cellular telephone to the receiver.

6. A method as in claim 4 wherein said credit card billing information is compared against a database of unacceptable numbers stored in said cellular telephone.

7. A method of processing and completing a credit card based cellular telephone communication, comprising the steps of:

obtaining billing information and a destination telephone number from a caller at a cellular telephone station which is initiating a call to a destination telephone number;

storing said billing information and said destination telephone number in a memory of the cellular telephone station;

calling, from said cellular telephone station, a central processing telephone number, different than said

destination telephone number and establishing a telephone connection between said cellular telephone station and a central processing station addressed by said central processing telephone number;

communicating said billing information and said destination telephone number from said cellular telephone memory to said central processing station;

establishing a telephone call to said destination telephone number from said central processing telephone number, and connecting said cellular telephone station to said destination telephone number via said central processing telephone number; and

controlling billing of charges for said telephone call from said central processing station, including monitoring a duration of said telephone call from said central processing station.

8. A method as in claim 7 wherein said controlling billing comprises periodically polling a computer which controls long distance billing to obtain long distance billing information.

9. A method as in claim 8 comprising the further steps of monitoring a length of said telephone call, determining when a total charge for the telephone call exceeds a prestored limit; and terminating the telephone call when said total charge exceeds said prestored limit.

10. A method as in claim 7 wherein said connecting step uses digital telephone system messages and data and calls such as GSM 900, TDMA, SMR or other similar digital technologies.

11. A cellular telephone communication and billing system, comprising:

a cellular telephone, comprising;

a keyboard through which a destination telephone number is entered to initiate a call to a destination;

a credit information inputting device, through which credit information is input as a source of payment for the call to the destination;

a memory, storing the entered credit information and the destination telephone number from a caller;

a dialer, programmed to dial only a central processing telephone number, different than said destination telephone number when a call is commanded, said dialer dialing no number other than said central processing number when the call is commanded, said central processing number being a telephone number of a processing center where billing information is processed;

a data sending element, transferring said billing information and said destination telephone number from said memory to [a location of] said central processing telephone number when said call is connected; and

a remote computer, located at said processing center, receiving said billing information and destination telephone number, and completing a call to said destination telephone number, and monitoring and controlling billing activities.

12. A cellular telephone and billing system, comprising:

a cellular telephone station, including a cellular communication processor, a credit card input device operating to receive credit card information, a destination telephone number input device through which a destination telephone number is entered, a cellular telephone number dialer, and a processor, said processor controlling said cellular telephone number dialer to dial a prestored telephone number, different than said destination telephone number, whenever a call is initiated, and controlling said dialer so that only said prestored telephone number, and not said destination number, can be dialed when said call is initiated and credit card information is entered;

a mobile telephone switching office, communicating with said cellular telephone station, and receiving information therefrom including said prestored telephone number and communications information;

a local central office, connected to said mobile telephone switching office by land-line wires, said local

central office switching a call from said mobile telephone switching office;

a remote central office, connected to said local central office via a telephone trunk, said remote central office being one which services said prestored telephone number;

a processing device, connected to receive communications via said prestored telephone number, said remote central office connecting said call to said processing device, said processing device receiving said credit card information and verifying validity of said credit card information, and said processing device receiving said destination telephone number entered on said destination telephone number input device and, if said credit card information is valid, completing a call to said destination telephone number, and connecting said call to said destination telephone number.

13. A system as in claim 12, wherein said processing device completes the call to the destination by forming a three-way telephone call between said cellular telephone station, said processing device and said destination.

14. A system as in claim 12, wherein said processing device completes said call by controlling said

remote central office to directly connect said cellular telephone station to said destination.

15. A system as in claim 12, wherein said prestored telephone number is a toll-free telephone number.

16. A system as in claim 12 wherein said cellular telephone station includes an encryption processor which operates to encrypt said credit card information and to send encrypted credit card information to a connection with said prestored telephone number.

17. A method of controlling a credit card operation of billing for credit card operated cellular telephone calls, comprising:

entering a credit card into a credit card reader on a cellular telephone to enter credit card information thereinto;

entering a destination telephone number into the cellular telephone;

determining when entry of said destination telephone number has been completed;

upon determining that entry of said destination telephone number is completed, dialing a telephone number of a processor, said telephone number of said processor being different than said destination telephone number;

transmitting a message including at least said credit card information and the destination telephone number to said processor;

determining, using said processor, whether said credit card information is valid;

if said determining step determines that said credit card is valid, using said processor to establish a telephone connection with said destination telephone number via said processor; and

using said processor to monitor and control billing of said cellular telephone.

18. A method as in claim 17, further comprising determining, in said processor, if an incoming call is an authorized call.

19. A method as in claim 18, wherein said determining comprises decrypting an incoming message, and determining if the decrypted message indicates an authorized message.

20. A method as in claim 18, wherein said telephone connection is established by forming a three way call between the cellular telephone, said processor and said destination.

21. A method as in claim 18, wherein said telephone connection is established by said processor controlling a telephone central office to form a connection between the cellular telephone and said destination.

22. A method as in claim 17 wherein said determining includes counting digits of the destination telephone number and determining, from said counting, whether the telephone number is complete, said determining including determining whether an entered telephone number is local or long distance, determining a necessary number of digits to complete said telephone call, and counting said necessary number of digits.

23. A method as in claim 17 further comprising determining unauthorized charge;

determining a current charge; and

dropping the call when the current charge exceeds the authorized charge.

24. A method of controlling a credit card-based cellular telephone, comprising:

entering a credit card into a credit card reader on a cellular telephone to enter credit card information thereinto;

entering a destination telephone number into the cellular telephone;

determining when entry of said destination telephone number has been completed;

controlling said cellular telephone so that it can only call a telephone number of a processor, said telephone number of said processor being different than said destination telephone number;

transmitting a message including at least said credit card information and the destination telephone number to said processor;

determining, using said processor, whether said credit card information is valid;

if said determining step determines that said credit card is valid, using said processor to establish a telephone connection with said destination telephone number via said processor; and

using said processor to monitor billing.

25. A cellular pay telephone assembly comprising:

a cellular telephone body, including a front surface, a second surface including an electrical contact set, and first and second side surfaces, each said side surface extending between said front surface and said second surface, said front surface including at least a keypad, said telephone also including a receiver, a transmitter and an antenna;

a slot assembly including first and second substantially flat side surfaces which are substantially parallel to one another and which define a reading area therebetween, and said slot assembly also including and having its inside area bounded by a bottom surface which is a substantially flat surface extending between first portions of respective first and second side surfaces of said slot assembly, said slot assembly located adjacent and bordering said first side of said cellular telephone body;

a reader assembly, extending into said inside area of said slot assembly, said reader assembly having a reading surface positioned to read information from an element which is passed through said inside area of said slot assembly;

an electronic assembly, including electronic circuitry thereon which drives the reader assembly and receives and interprets information therefrom; and

a battery, electrically in contact with said electrical contact on said second surface, said battery providing electrical power for said electronic circuitry.

26. A telephone assembly as in claim 25 when said first and second side surfaces of said slot assembly include first parallel portions, and second and third non-parallel portions at distal ends thereof, said second and third non-parallel portions include a tapered

location at which a distance between said first and second surfaces is increased.

27. A telephone assembly as in claim 25 further comprising an interface assembly, including a clip and slot assembly coupled to said second surface of said body of said cellular telephone, said clip and slot assembly mating with corresponding structures on the battery to hold the battery in place and including an electrical contact set which is electrically coupled to said electrical contact on said second surface.

28. A telephone assembly as in claim 27 wherein said electrical contact set on said interface assemble is of a shape and arrangement to mate with said corresponding contacts on said battery.

29. A telephone assembly as in claim 25 further comprising an interface assembly, connected to said slot assembly, said interface assembly coupled to said second surface of said body of said cellular telephone and including a planar plastic sheet connected to said slot assembly, said planar plastic sheet defining two parallel surfaces, a first of said parallel surfaces having a clip and slot assembly, said clip and slot assembly mating with corresponding structures on the battery to hold the battery in place and having an electrical contact set

which is electrically coupled to said electrical contact on said second surface, and receiving the battery connected thereto, and a second of said parallel surfaces connected against said second surface of said cellular telephone body, said slot assembly extending above said second parallel surface in a plane perpendicular to said first and second parallel surfaces, in a direction away from said first parallel surface and located bordering said telephone body.

30. A pay cellular telephone, comprising:

a cellular telephone including a body having first and second sides, a front surface and a second surface including an electrical contact set, said front surface including at least a keypad thereon, said telephone also including a receiver, a transmitter and an antenna, and said telephone including electrical circuitry therein which places a cellular telephone call to a desired telephone number responsive to information entry on said keypad;

a slot assembly including first and second side surfaces which are substantially parallel to one another, and are substantially flat, and including a bottom surface which is a substantially flat surface and which extends between first portions of respective said first and second side surfaces of said slot assembly, a reading area defined between said first and second side surfaces

and said bottom surface, said slot assembly located adjacent said first side of said cellular telephone body;

a reader assembly, located extending into said reading area of said slot assembly, positioned to read information from an information-containing element which is passed between said first and second surfaces of said slot assembly;

reader electronic circuitry associated with said reader assembly, driving said reader assembly to read said information, and to translate said information into a form which can be interpreted by said reader electronic circuitry, said reader electronic circuitry including enabling circuitry structure, which selectively enables said telephone electronic circuitry only when said information meets a predetermined condition; and

a battery connected to said second surface providing power for said telephone electrical circuitry and for said reader electronic circuitry.

31. A method of retrofitting a cellular telephone to accept payment information, comprising the steps of:

removing a battery from an existing cellular telephone;

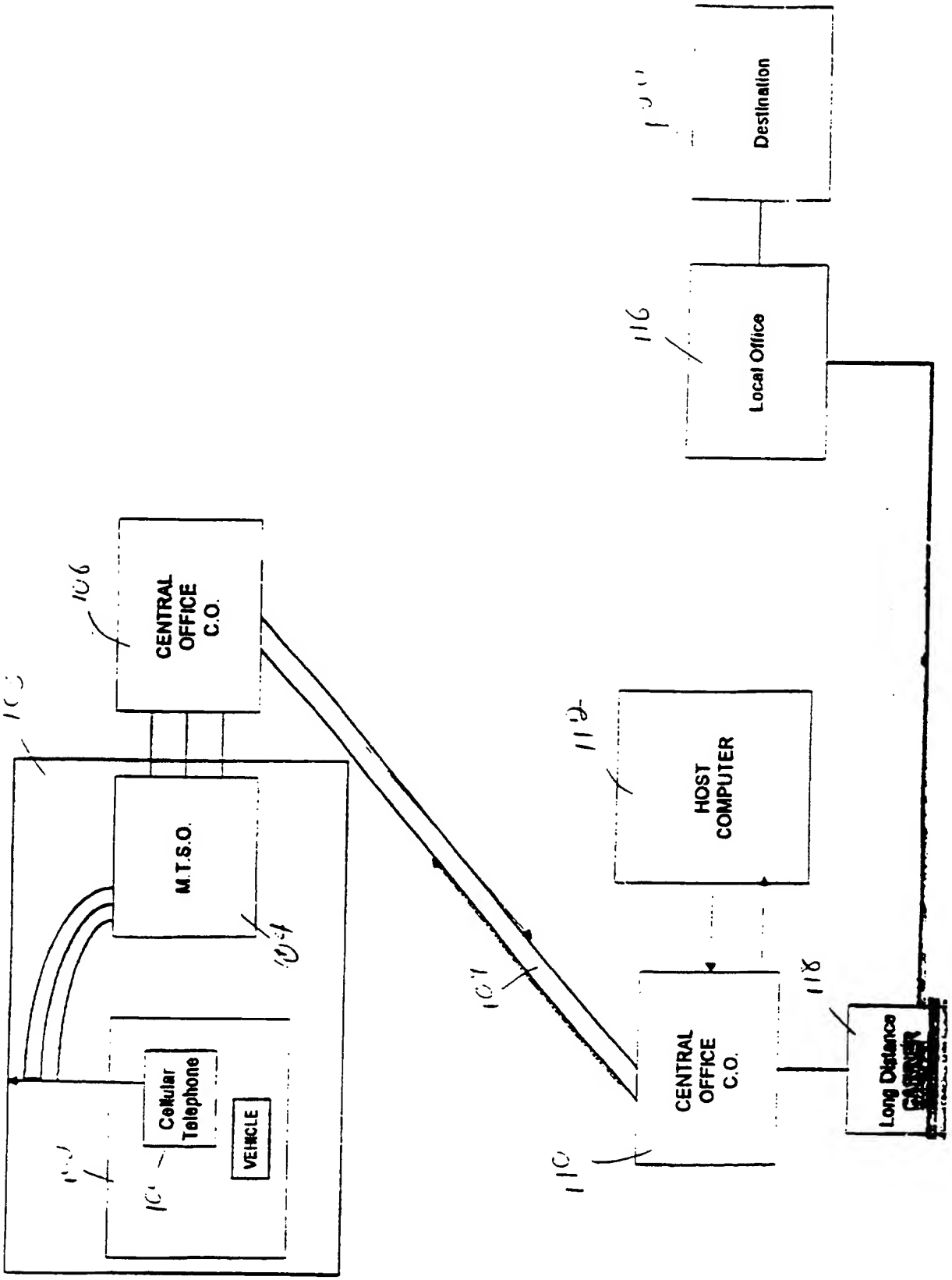
providing an interface assembly, said interface assembly including holding elements which mate with existing holding structures on the battery, and including first connectors which connect to existing battery

connectors on the cellular telephone, and second connectors which connect to electrical connections on the battery without modification to the battery, and which includes a slot assembly, said slot assembly including first and second substantially flat side surfaces which are substantially parallel to one another and which define a reading area therebetween, and said slot assembly including a bottom surface which is a substantially flat surface extending between first portions of respective first and second side surfaces of said slot assembly, said slot assembly located adjacent one of said sides of said cellular telephone body; a reader assembly, extending into said reading area of said side surfaces of said slot assembly, said reader assembly having a reading surface positioned to read information from an element which is passed through said reading area of said slot assembly; and an electronic assembly, including electronic circuitry thereon which drives the reader assembly and receives and interprets information therefrom;

attaching said interface assembly to said cellular telephone with the second surface thereof facing outward; and

connecting said battery to said second surface to make electrical contact therewith and to operate said telephone and said circuitry based on power therefrom.

Fig 1


Destination
Local Office
CENTRAL OFFICE C.O.
HOST COMPUTER
M.T.S.O.
CENTRAL OFFICE C.O.
Long Distance
Cellular Telephone
VEHICLE

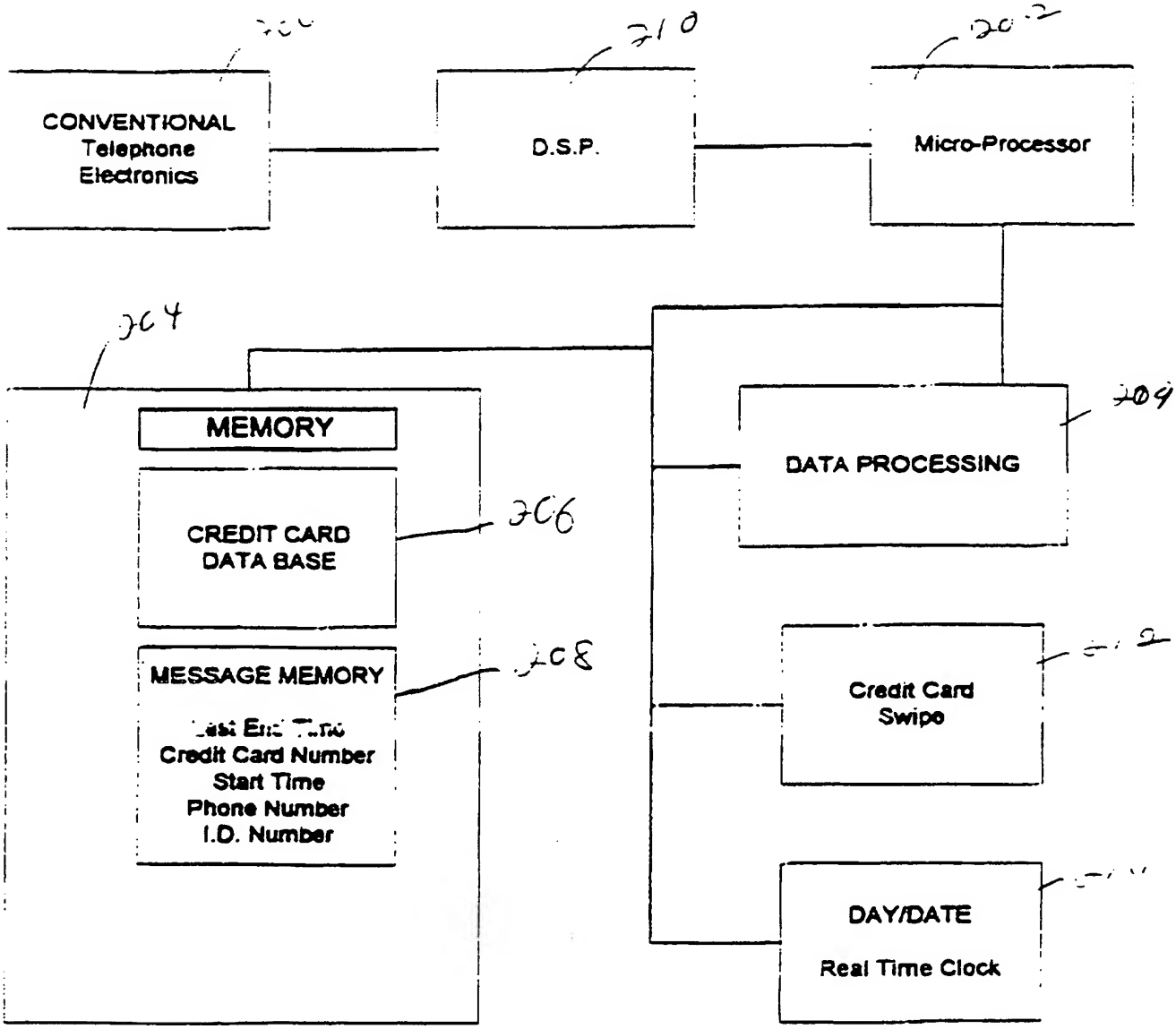


FIG 2

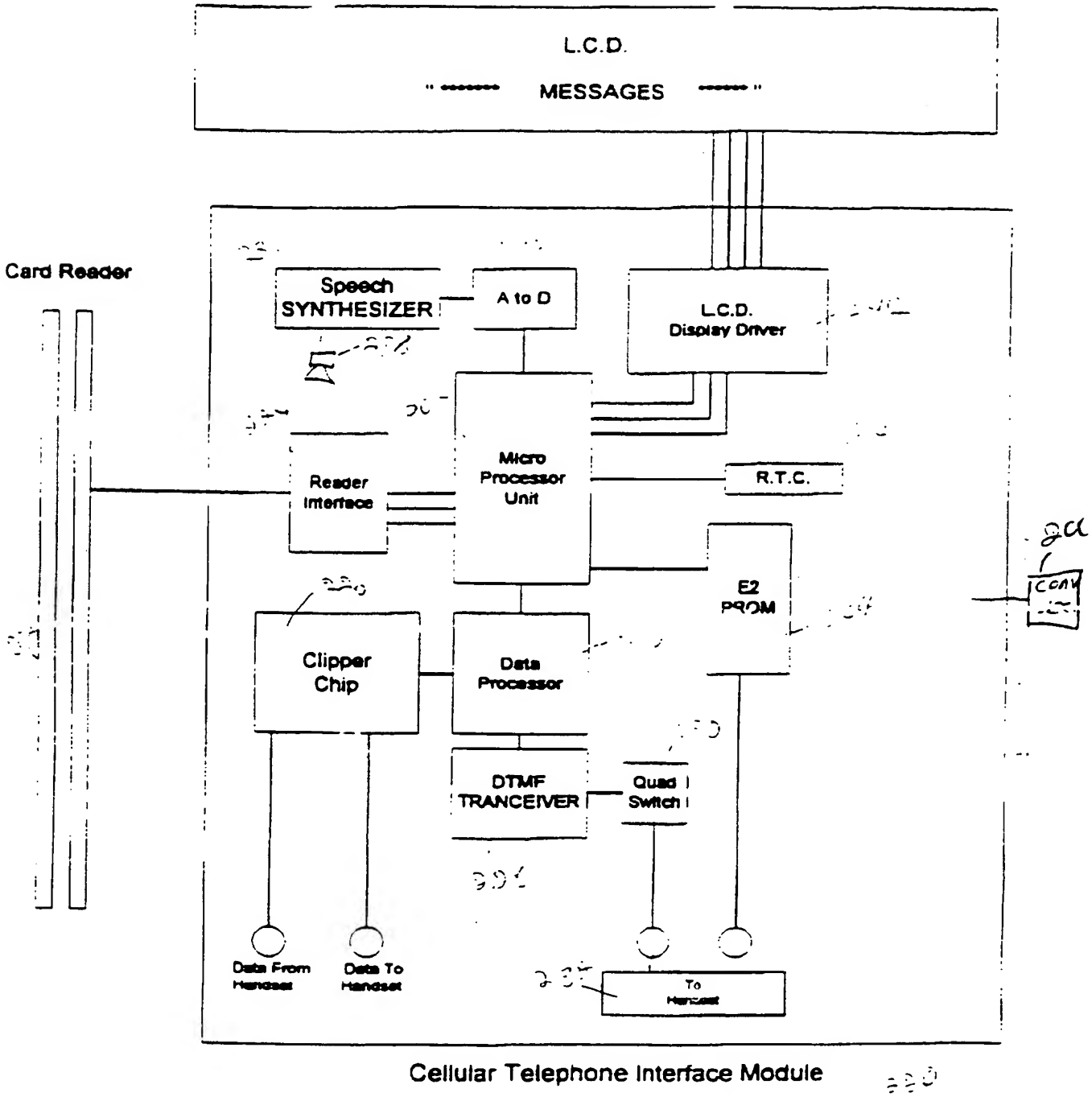

L.C.D.
MESSAGES
Card Reader
Speech SYNTHESIZER
A to D
L.C.D. Display Driver
Micro Processor Unit
Reader Interface
R.T.C.
E2 PROM
Clipper Chip
Data Processor
DTMF TRANCEIVER
Quad Switch
Data From Handset
Data To Handset
To Handset
Cellular Telephone Interface Module

FIG. 2A

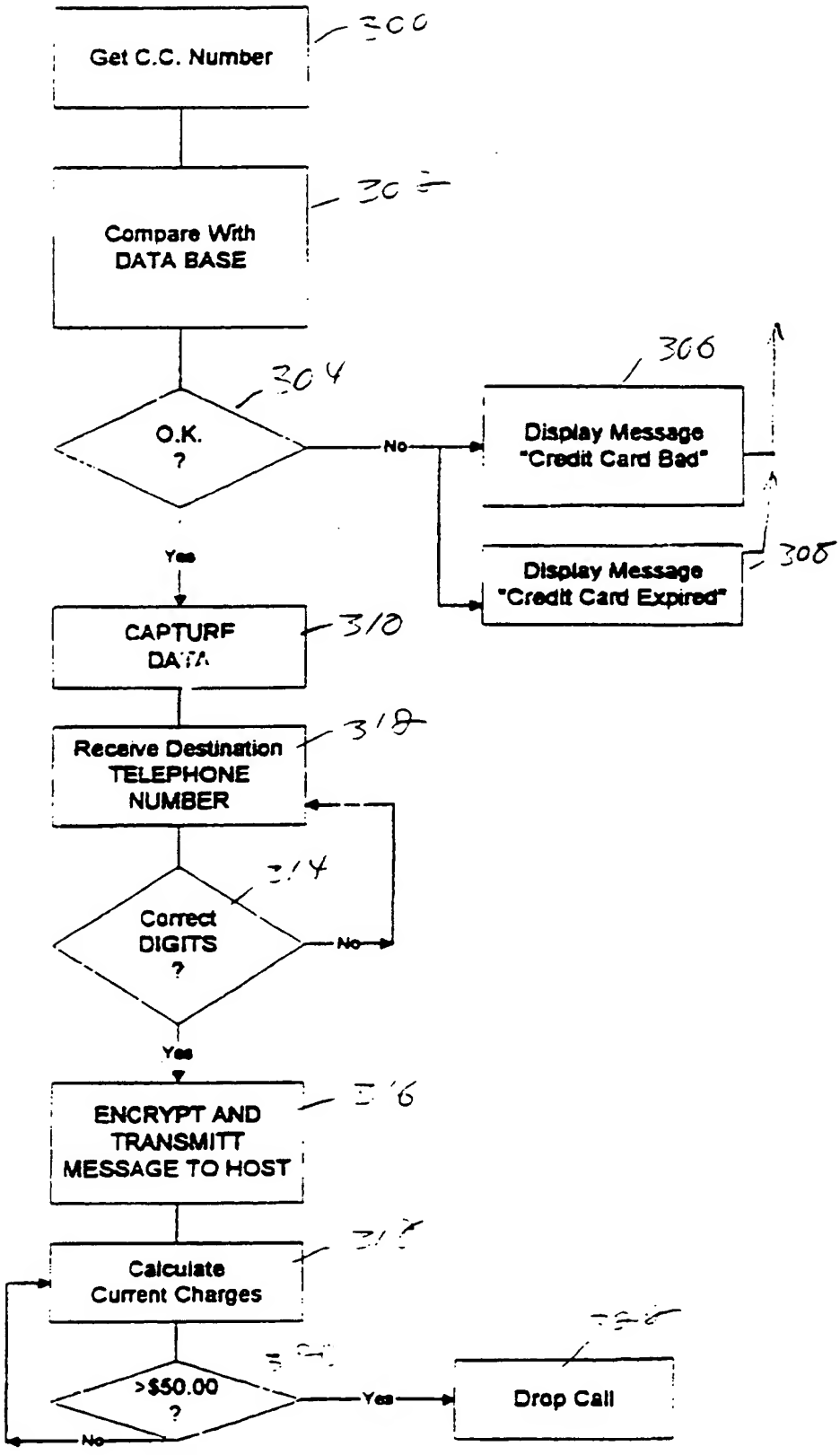


FIG 3

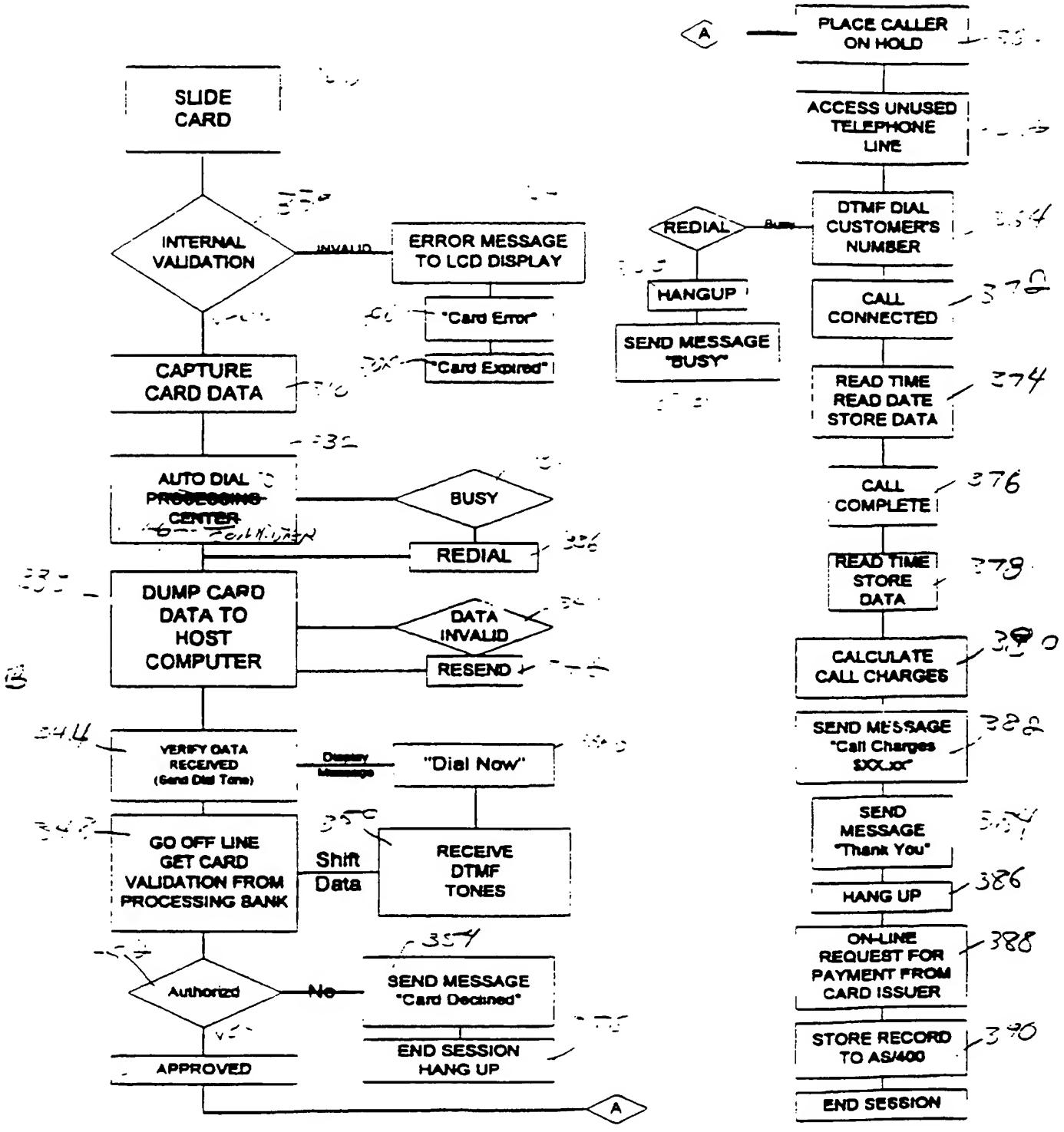

SLIDE CARD
INTERNAL VALIDATION
INVALID
ERROR MESSAGE TO LCD DISPLAY
"Card Error"
"Card Expired"
CAPTURE CARD DATA
AUTO DIAL PROCESSING CENTER
BUSY
REDIAL
DUMP CARD DATA TO HOST COMPUTER
DATA INVALID
RESEND
VERIFY DATA RECEIVED (Send Dial Tone)
Display Message
"Dial Now"
GO OFF LINE GET CARD VALIDATION FROM PROCESSING BANK
Shift Data
RECEIVE DTMF TONES
Authorized
No
SEND MESSAGE "Card Declined"
END SESSION HANG UP
APPROVED
A
A
PLACE CALLER ON HOLD
ACCESS UNUSED TELEPHONE LINE
REDIAL
Busy
DTMF DIAL CUSTOMER'S NUMBER
HANGUP
SEND MESSAGE "BUSY"
CALL CONNECTED
READ TIME READ DATE STORE DATA
CALL COMPLETE
READ TIME STORE DATA
CALCULATE CALL CHARGES
SEND MESSAGE "Call Charges $XX.xx"
SEND MESSAGE "Thank You"
HANG UP
ON-LINE REQUEST FOR PAYMENT FROM CARD ISSUER
STORE RECORD TO AS/400
END SESSION

FIG 3A

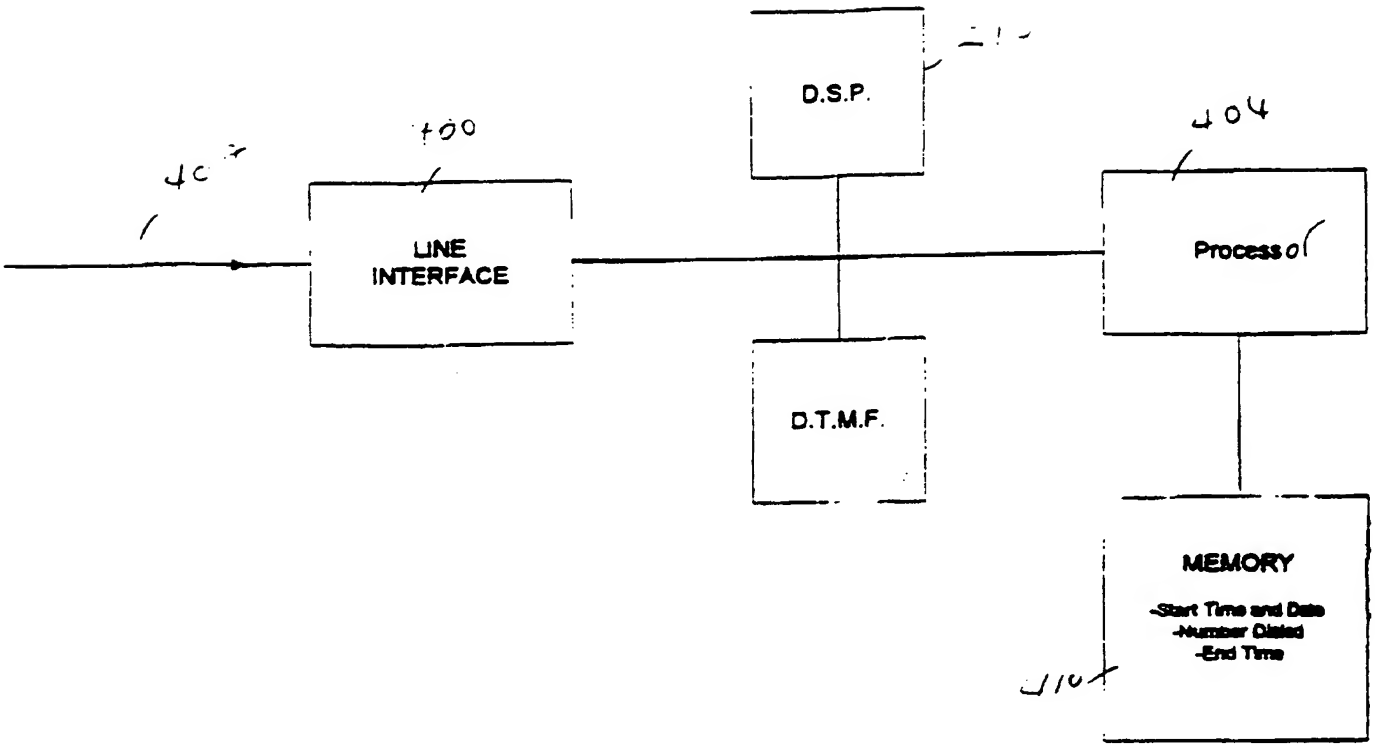

D.S.P.
LINE INTERFACE
Processor
D.T.M.F.
MEMORY
-Start Time and Date
-Number Dialed
-End Time

FIG 4

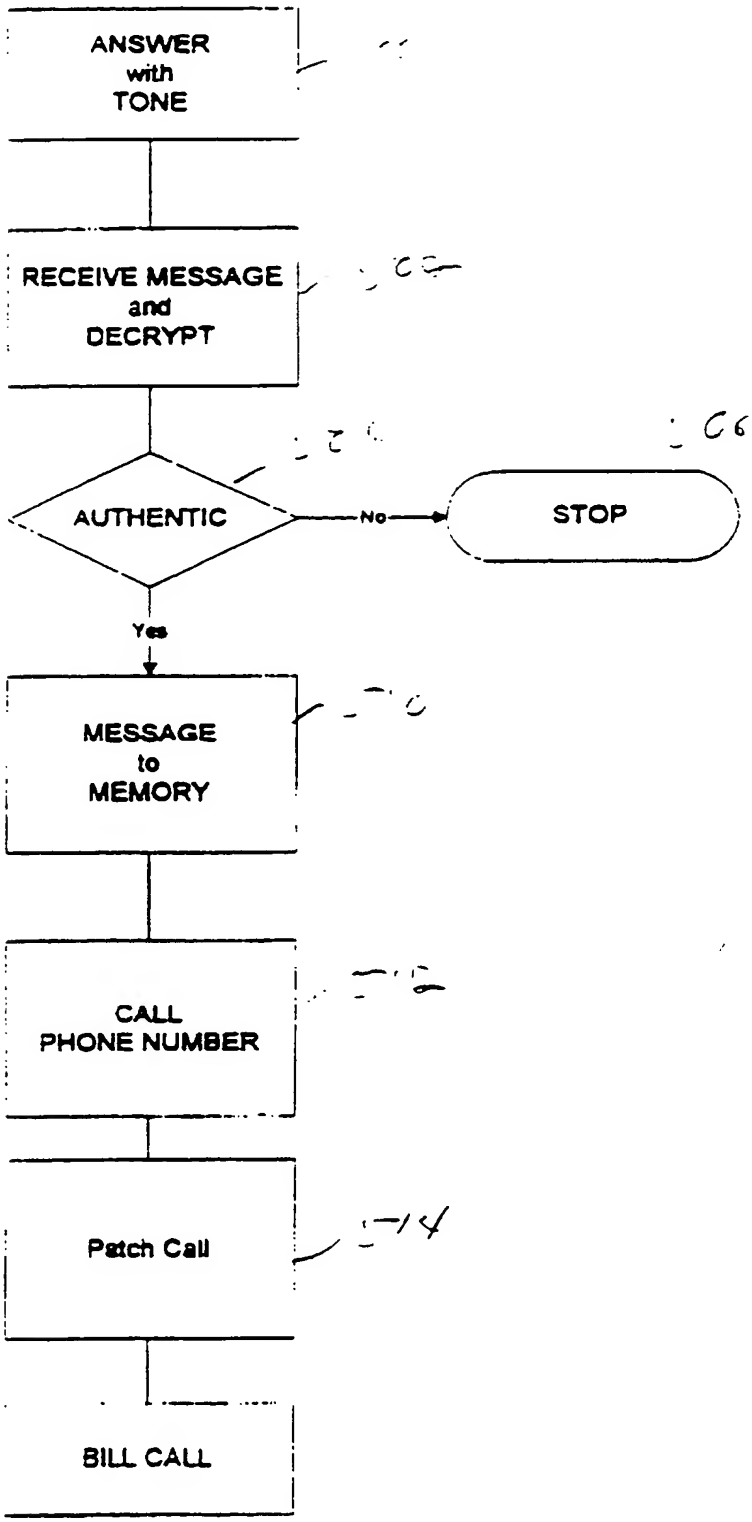


FIG 5

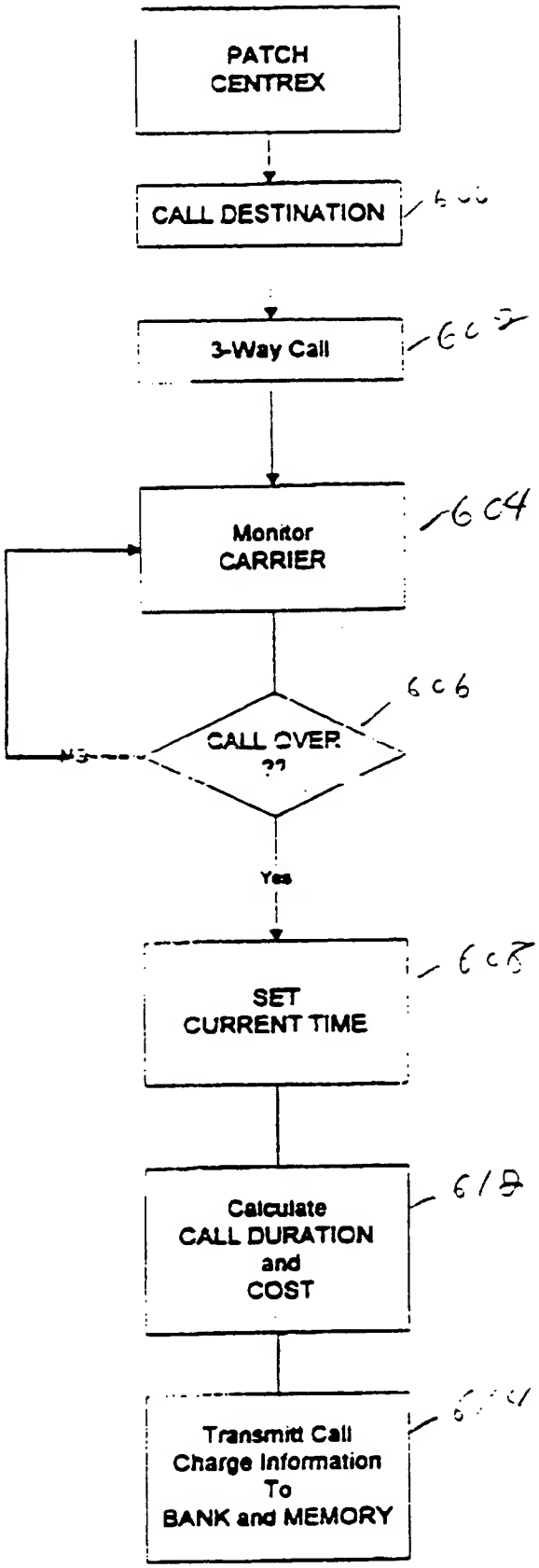
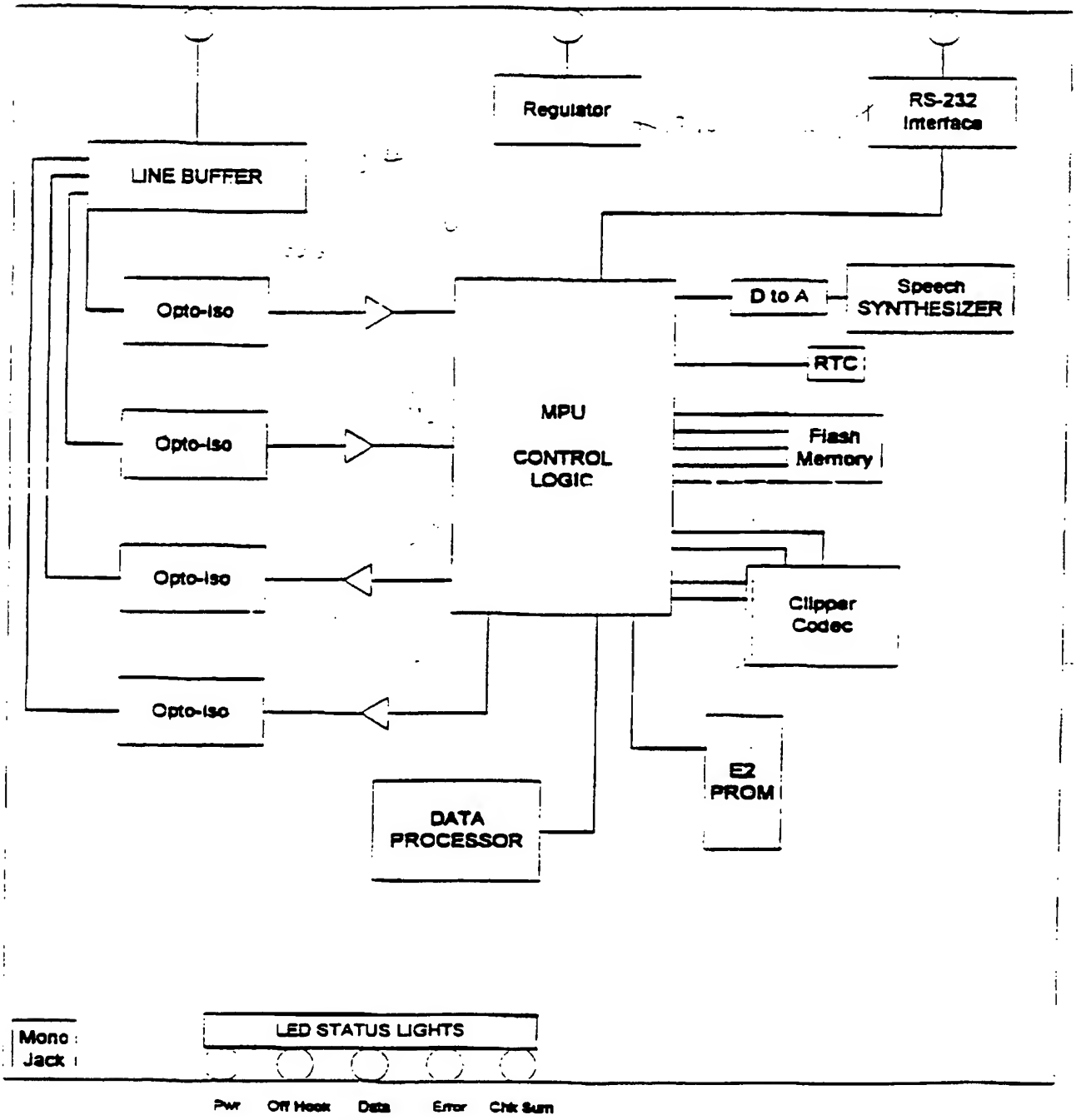


FIG 6



TELEPHONE LINE CARD INTERFACE

FIG 7

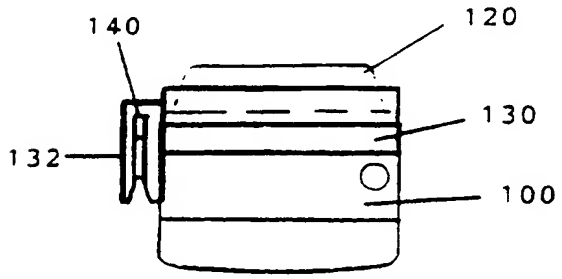


FIG. 3B

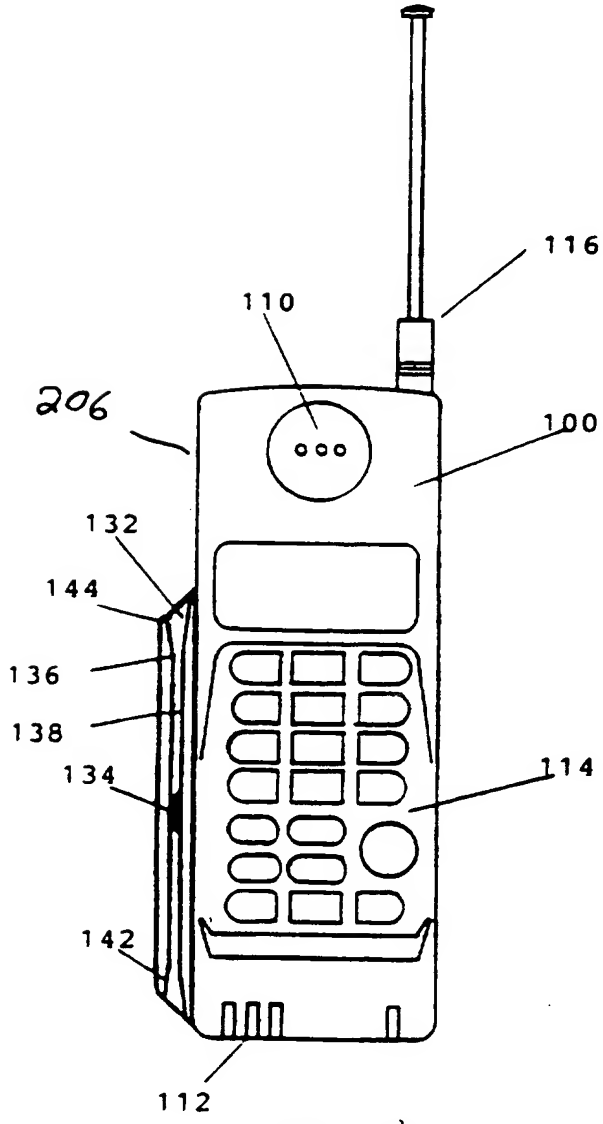


FIG. 1H

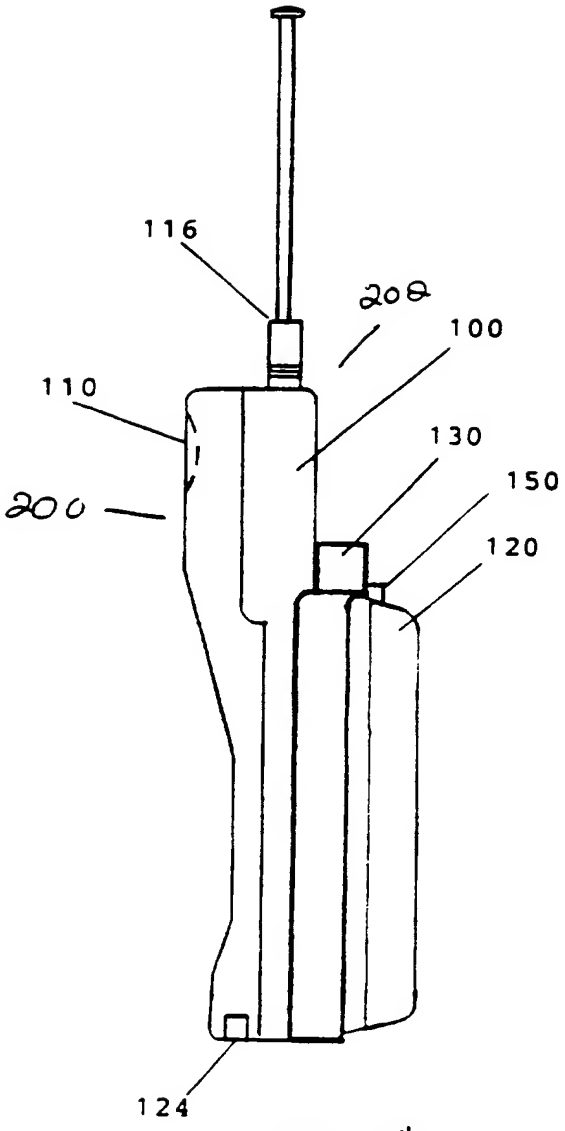


FIG. 2B

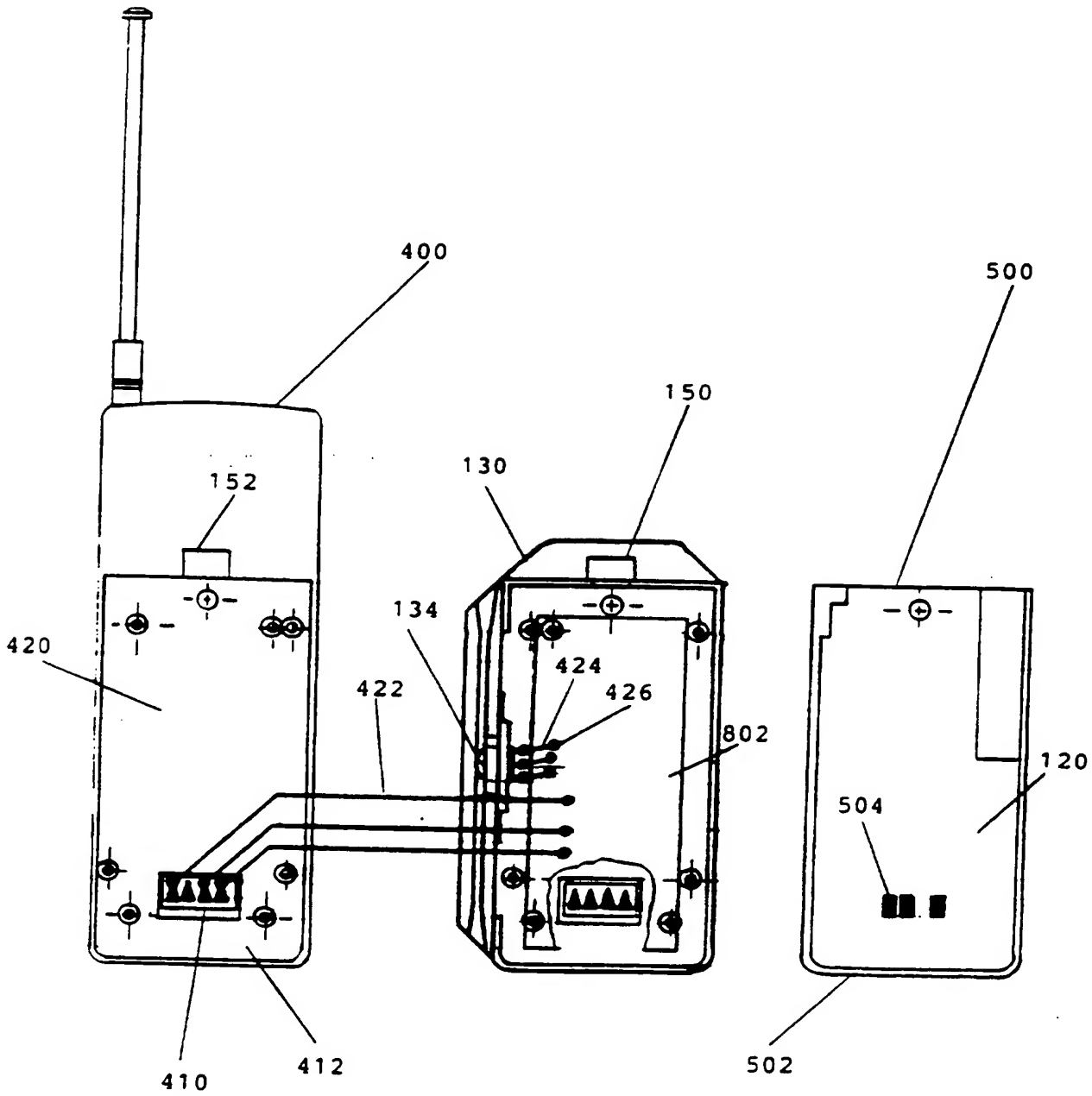


FIG. 4A

FIG. 5A

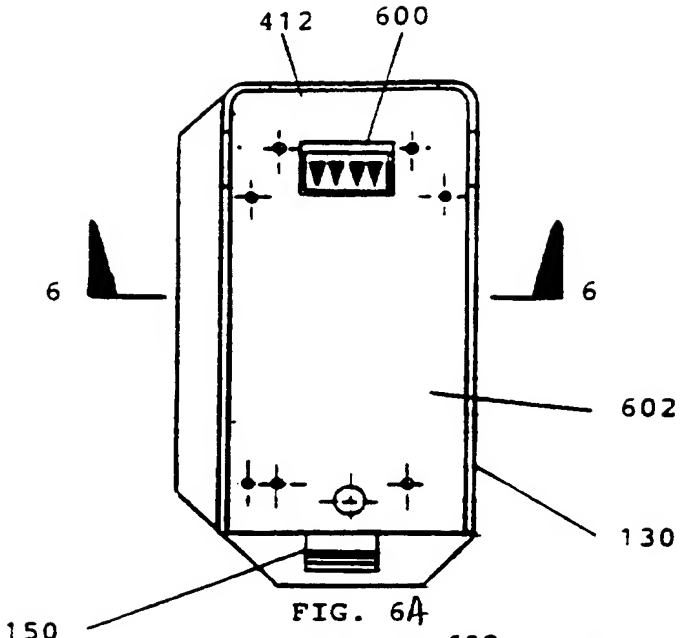


FIG. 6A

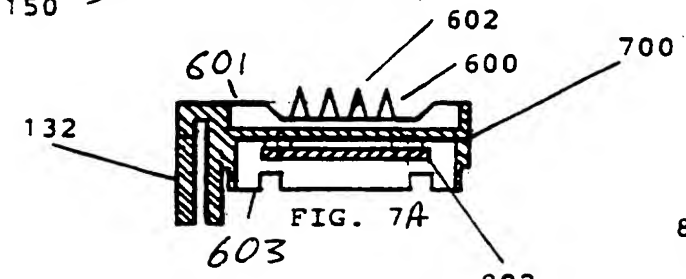


FIG. 7A

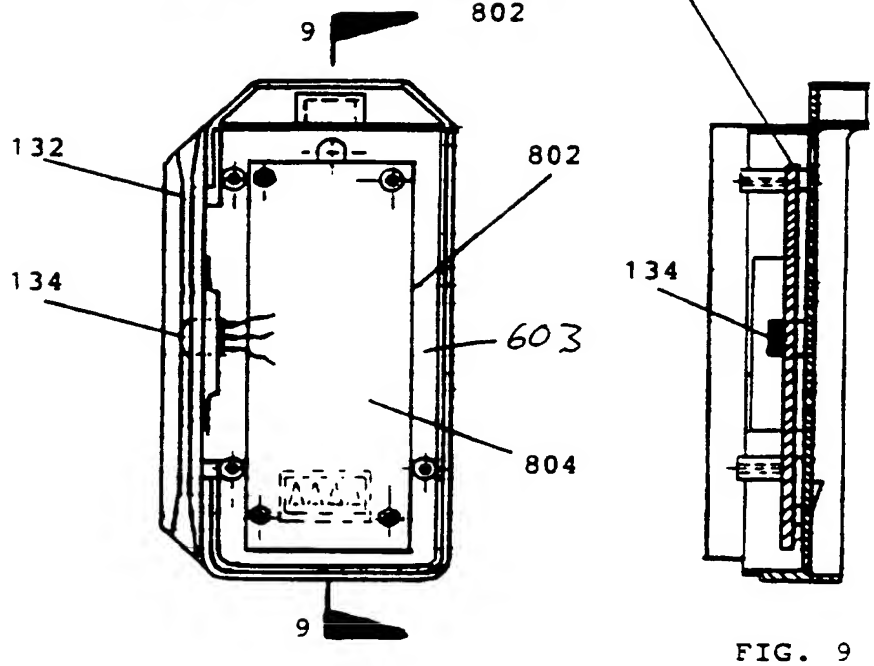


FIG. 8

FIG. 9

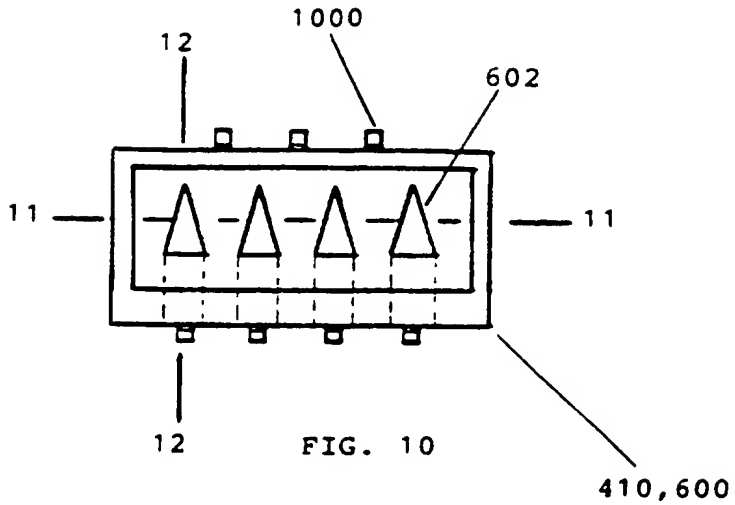


FIG. 10

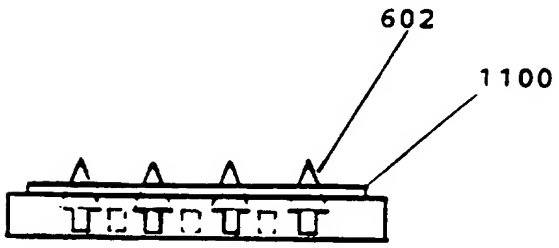


FIG. 11

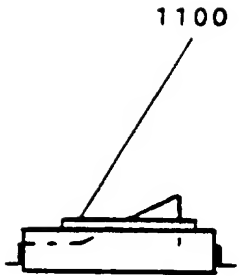


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/10361

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04Q 7/22
US CL :379/59
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/59, 58,63,91,111,112,114,121,144,145,357,430,447,450; 455/33.1,89,90; 235/380,381

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,777,646 (HARRIS) 11 October 1988, see the entire document.	1-8, 10-21, 24
Y	US, A, 5,109,401 (HATTORI ET AL.) 28 April 1992, see col. 1, line 43 to col. 2, line 4.	9,23
Y	US, A, 4,737,975 (SHAFER) 12 April 1988, see cols. 10 and 11.	22
Y	US, A, 4,860,336 (D'AVELLO ET AL.) 22 August 1989, see figure 5.	25, 30
Y	US, A, 5,208,446 (MARTINEZ) 04 May 1993, see entire document.	25, 30
Y,P	US, A, 5,408,513 (BUSCH, JR. ET AL.) 18 April 1995, see figure 2.	26

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 OCTOBER 1995	24 OCT 1995
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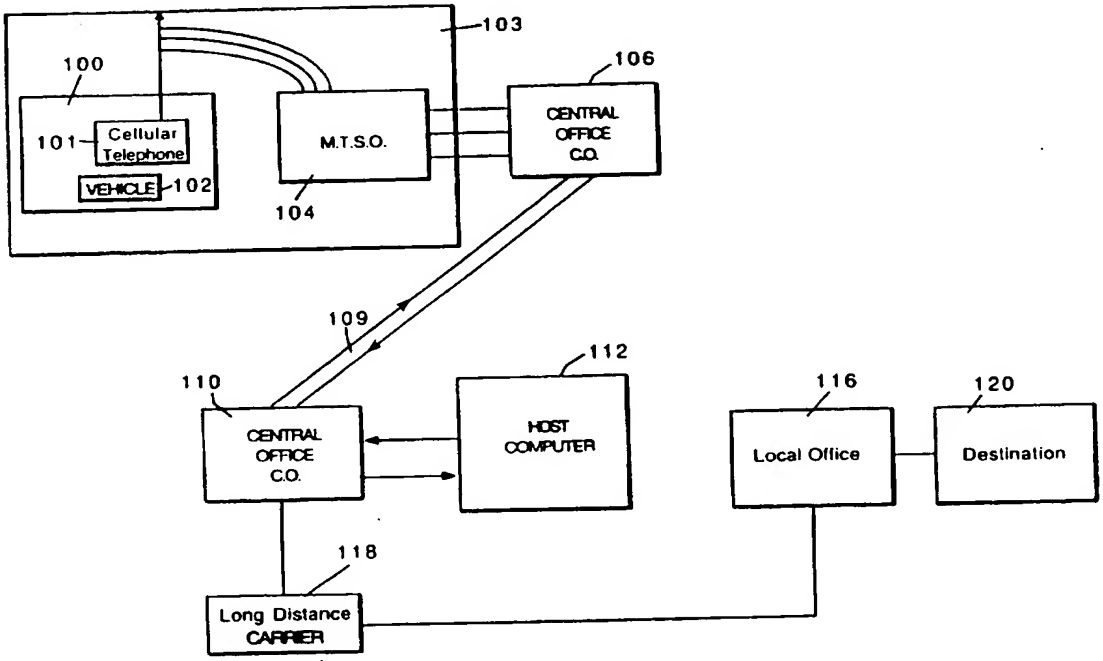

(57) Abstract

A credit card based cellular telephone billing system which enables billing independent of either the mobile telephone switching office (104) or local telephone switches (116). Billing is carried out at a central location (112). All calls are routed to that central location (112).

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CELLULAR TELEPHONE CREDIT CARD BILLING SYSTEM

Field of the Invention

The present invention describes a cellular telephone system which uses credit card billing, in which billing is carried out independent of the cellular carrier.

Background and Summary of the Invention

Cellular telephone has relieved the telephone system's dependence on wires for communication by their installation in mobile platforms. Cellular telephones have typically been associated with a single billed party. Cellular pay phones have been used in the past in only very limited circumstances.

One of the first wireless payphones was fully developed by GTE. GTE has furthered this concept with the GTE credit card-activated cellular phone which is manufactured by OKI Telecom of Tokyo, Japan. Various other technologies have built on the basic GTE system.

A major problem in all existing cellular pay phones is the monitoring and transfer of billing data. A cellular telephone call includes two parts: the cellular part, which is the wireless connection between the cellular telephone and the cellular telephone provider equipment ("the mobile telephone switch office" or MTSO), and the land line part which is the standard connection between the MTSO and the called party.

The cellular telephone system uses a number of paging and overhead signalling messages to allow continuous transfer of data between the mobile telephone and the mobile telephone switch office. The MTSO therefore always knows the position of the cellular telephone, whether or not it is engaged in a call, and the destination of a call. The cellular network can easily track the billing because it monitors the called party, the calling party, and length of time of the call. The prior art has therefore used the cellular network to handle billing of all cellular charges.

The U.S. AMPS standard requires each cellular telephone unit to send and receive packets of data, bundled as data words, to the mobile telephone switch office. These data words are labelled A, B, C, D, E, F and G. Each word in the string includes recognition data including the electronic serial number ("ESN") of the mobile unit, and the mobile telephone number and the system I.D. Some of these data words, including the words E and F are unused, and are intended for future developments.

U.S. Patent No. 4,777,646 suggests using these E and F words to carry billing information for a credit card-operated cellular telephone. In operation, the mobile telephone network must decode the E and F information, and obtain the billing information, such as credit card number and call destination, therefrom.

A similar system is currently in use by GTE which uses DTMF tones and modem protocols to shift and transfer data from the mobile unit to a billing computer located at the mobile telephone switching office. This necessitates, however, making an arrangement with the owner of the mobile telephone switching office. This causes a problem when a first company wants to set up a cellular telephone billing system of this type, but the MTSO is owned by a competitor of that first company.

Another problem with this system is that it is not clear whether all versions of the cellular network will recognize the E and F words. It is clear however, that the newer digital systems, such as ISDN, TDMA, SMR and the other systems under implementation will not recognize the E and F words. The inventor of the present invention recognized that a system which performs billing independent of the cellular switch is necessary.

Another problem is that this system simply stores the credit card billing information as received in the computer, and periodically, e.g., nightly or in actual practice weekly or monthly, transmits the information to the bank. There is no real-time verification of the credit card numbers used, and the billing information may not arrive at the bank until as long as a month later. This problem is exacerbated by the last phone call problem. This system requires the cellular telephone unit initiating the call to keep track of how long the

call has continued. The system does not know how long the call has lasted, however, until the end of the call. At that time, the transmission is over, and so the length of time of the telephone call is maintained in a memory of the cellular telephone. This information is downloaded at the beginning of the next telephone call. This means that the completion information is sent only much later than the actual call. If the telephone is infrequently used, the completion information, and hence the billing, may be completed only very much later than the actual call completion.

While a one-time per day or week etc processing of bank records was feasible in 1980, the increasing proliferation of credit and credit card fraud has caused banks to require that charge transactions be processed at the time the actual transaction occurs, not hours or a day or two later. This produces another specific problem with a credit card operated telephone. Specifically, actual credit card approval can take many seconds to carry out. In earlier systems, credit approval was carried out over the cellular network, and took very long to effect. This has two problems: it lowers the carrier's profit margin, but also, it provides frustration to the user; waits as long as 50 seconds before credit approval is obtained are not uncommon. Such waits make using such a telephone extremely frustrating.

The inventor of the present invention noticed these problems, and solved them by defining a credit-card activated cellular telephone which has its billing characteristics independent of the setup at the cellular carrier or the setup at the local telephone office. It is easily installed in any platform location, and does not require any special cooperation from any cellular carrier. The system operates quickly and efficiently and produces virtually real-time billing and requires no billing information from the cellular carrier.

Examples of platforms in which this system could be installed include limousines, trains, taxis, boats, airplanes, automobiles including rental automobiles, electric golf carts and the like.

Previous attempts to outfit such platforms with cellular credit card-driven devices have met with substantial frustration. The inventor of the present invention found that one main problem involves the dependence of existing systems with the cellular switch and cellular carrier. The present invention obviates this dependence.

Different carriers handled different parts of the country. It was necessary to obtain an agreement with each carrier in the part of the country tha the operation was to occur. This is, practically speaking, impossible, because, inevitably, the party doing the

cellular operation was a competitor of at least one of the local companies.

Previous systems did not allow real time production of the bills. This also caused problems with collection of the credit card amounts. It is easy to accumulate enormous bills from cellular telephone usage. The old systems, in which the information would be collected only days or weeks later made it more difficult to actually collect the credit card amounts from the user. The present invention allows monitoring this information in substantially real time.

Brief Description of the Drawings

These and other aspects of the invention will now be described in detail with reference to the accompanying drawings, wherein:

Figure 1 shows a diagram of the overall communications scheme used according to the present invention;

Figure 2 shows a basic block diagram of the cellular telephone used according to the present invention;

Figure 2A shows a more detailed block diagram of the cellular telephone of the present invention;

Figure 3 shows a flowchart which is executed by the microprocessor of the present invention according to a first aspect thereof;

Figure 3A shows a flowchart of processes executed by both the microprocessor of the cellular telephone and the processing unit in the host computer according to a second embodiment of the invention;

Figure 4 shows a block diagram of the central processing office host computer;

Figure 5 shows a flowchart of a second embodiment of operation of the host computer;

Figure 6 shows a flowchart of a process executed by the processor according to another embodiment of the present invention; and

Figure 7 shows a block diagram of a telephone line interface unit used in the host computer of the present invention.

Figure 1A shows a front view of the modified cellular telephone according to the present invention;

Figure 2B shows a side view of this cellular telephone;

Figure 3B shows a bottom view of the cellular telephone;

Figure 4A shows an assembly view showing the unmodified cellular telephone connected to the interface assembly;

Figure 5A shows the battery as disconnected from the interface assembly;

Figure 6A shows the interface assembly;

Figure 7A shows a cross section of the interface assembly along the line 6-6 in Figure 6A;

Figure 8 shows the interface assembly;

Figure 9 shows a cross section along the line 9-9 in Figure 8;

Figure 10 shows a contact assembly used on the interface assembly of the present invention;

Figure 11 shows a cross section across the line 11-11 in Figure 10;

Figure 12 shows a cross section along the line 12-12-12 in Figure 10.

Description of the Preferred Embodiments

A block diagram of the overall communication scheme used according to the present invention is found in Figure 1. The present scheme uses a system whereby a cellular telephone 100 installed in any platform 102, virtually anywhere in the world, can operate independent of the carrier's computer.

The credit card operated telephone 100 is installed in platform 102, which as described above, could be an automobile, train, taxi, boat, airplane, electric golf cart, hired car or the like. This telephone operates in the normal cellular way according to the cellular network processes as described, for example, in U.S. Patent No. 3,906,166, the disclosure of

which is incorporated by reference herein. The telephone 100 communicates with the mobile telephone switching office 104 servicing its current cell 103. MTSO 104 is operated by whatever cellular provider services telephone 100, and treats the communications from telephone 100 just like any other cellular message. MTSO 104 passes requests for calls to local switching office 106 and also receives incoming calls therefrom. CO 106 is the central hub office of the MTSO 104. Local office 106 is generally run by the local telephone company handling telephone traffic for the area of the cell 103.

According to the present invention, all calls initiated from telephone 100 are placed to host computer 112, which also has a central switching office shown as office 110. Local office 106 connects to local office 110 over telephone trunk 109 in the conventional way.

According to the present embodiment, telephones 100 input credit card billing information as well as a destination telephone number from the user. Telephone 100, however, does not call the destination telephone number, but rather automatically dials a pre-programmed telephone number, e.g. an 800 number, which connects it to host computer 112.

Therefore, according to the present invention, the initiated telephone calls from every location are connected first to host computer 112.

Host computer 112 decodes the information indicating the telephone number to be called, and places an outgoing telephone call on line 114 to the destination 120, which is the destination indicated by the telephone number that the caller has entered. This means, however, that the call is actually relayed back to central office 110 which places the call to destination local office 116 which then connects with destination 120.

The connection must now be maintained. According to a first embodiment of the invention, central office 110 provides a "CENTREX" type system to the facility of host computer 112. The CENTREX system allows the local office 110 to carry out the functions of a PBX switch, including call forwarding and three way calling. The host computer 112 of this embodiment controls a three-way call between the incoming call and destination 120. This frees the host computer to do other work, but necessitates that one line be installed into the host computer premises for each call which is being handled. It also means, however, that host computer has complete real time monitoring capabilities for the call. Host computer 112 stores information indicating the location of destination 120, and from this can obtain the cost per minute for the long distance part of the call. It also knows the time duration of the call since one line of the computer remains on the line. From this it can calculate

the cellular charges which will be incurred by the cellular provider.

According to a second embodiment of the invention, the system uses a digital operation: preferably the "primary rate interface" service of the ISDN system. This allows the host computer to control the switching system within the central office 110 sufficiently to enable central office 110 to completely control the call, and host computer 112 to leave the line. Having left the line, however, host computer 112 can no longer carry out real-time telephone call monitoring. It should be understood that the digital system used could be GSM 900, TDMA, SMR or other similar digital technologies as an alternative to ISDN.

Host computer 112 has initiated the call, and therefore knows the beginning time of the call. Since the host computer leaves the call in this embodiment, however, the ending time of each telephone call is not known by host computer 112. Accordingly, according to this second embodiment, host computer 112 polls the long distance carrier 118 every ten minutes in order to obtain billing information about the duration of long distance calls. This duration information is used to calculate both long distance charges and cellular charges.

According to another aspect of the invention, useable, but less preferred, with both the first and the second embodiments, the telephone 100 stores the ending

time of the last call in its memory, and transmits this as part of the next call. This provides another check from which host computer can determine billing information. This system can be used for tracking local calls, for which the long distance carrier 118 does not have billing information. A basic block diagram of the telephone electronics of the telephone of the present invention is shown in Figure 2. The system is preferably a modified existing cellular telephone unit, modified to carry out additional functions. The block diagram shows the conventional telephone electronics generically as block 200. It should be understood that this includes the circuitry for carrying out all communications necessary according to the AMPS, TACS, TDMA, SMR and other cellular telephone standards.

Additional circuitry carries out the other functions necessary according to the present invention. Microprocessor 202 controls much of this additional operation. Memory 204 includes a number of embedded memories including a credit card database memory 206, and a message memory 208. Message memory 208 assembles the data message which is sent to the host computer 112 to begin the operation. Number crunching and data communications is controlled by a digital signal processor chip 210 which is preferably a Phillips chip number UMA 1000.

A more detailed block diagram is shown in Figure 2A. The cellular telephone interface module 220 includes a number of connected structures. The credit card information is input through card reader 222 to reader interface 224 which collectively form the credit card swipe device 212. Readers and reader interfaces of this type are conventionally available in the art. The output of reader interface 224 is provided to microprocessor 202. The data processor 209 includes associated circuitry for encryption here shown as clipper chip 226. Any other data encryption mechanism and decryption mechanism could alternately be used. The DTMF transceiver 228 provides the dialing capability through quad switch 230 to the telephone handset 232. In this embodiment, the memory 204 is an E^2PROM

The microprocessor also drives a speech synthesizer 234 through an A/D converter 236. Speech synthesizer 234 produces spoken speech through speaker 238. Messages can also be provided to the user on a liquid crystal display 240, driven by an LCD display driver 242.

The microprocessor controls the Figure 2 and Figure 2A structure according to the flowchart of Figure 3. At step 300, the microprocessor receives the credit card number from reader interface 224 of credit card swipe device 212. This credit card number is temporarily stored in the message memory 208. At step 302, the

credit card number is compared with database 206 of expired, invalid and stolen credit cards which is stored in E^2PROM 204. This database is periodically updated. Step 302 also compares the expiration date for the credit card with the current date from real time clock 214.

If either test fails, control passes to step 304 which produces an error message to the LCD display. If the credit card matches any data in the data base, the LCD display displays "card error" at step 306. If the expiration date test has failed, the LCD display displays "card expired" at step 308.

If, however, the card is found to be valid, the card data is captured at step 310 followed by control passing to step 312 where dialing is enabled by production of a dial tone by the conventional telephone electronics 200.

At this time, the user enters the destination telephone number, which is stored in message memory 208. Step 314 counts digits and determines if the message is completed. If the first digit is a "1", the call is a long distance call, and therefore that ten more digits will follow. If the first digit is other than a 1 or 0, then the call is a local call and only a total of seven digits will be entered. This may differ in some areas, such as Washington, D.C., where area codes are necessary even without 1 prefixes. If the first three digits are 011, then the system waits ten seconds after the last

digit before concluding that dialing is completed. Otherwise, the instant that the last digit is entered, the dialing is complete.

The microprocessor then immediately calls the host computer using a prestored number, e.g. an 800 number or a local access number. Upon connecting with the host computer 112, microprocessor 202 encrypts and transmits the message stored in message memory 208, which includes the last end time of the previous call, the current credit card number, the start time of the current call, and the desired telephone number at step 316.

According to the present invention, the credit card number is compared with the contents of the database at steps 302, 304. This comparison takes less than a second. An approval is not obtained for the specified credit card number, and this system instead takes advantage of the so called "floor limit" which is used by credit card systems.

The credit card companies have a floor limit, which is an amount below which credit card transactions will be accepted independent of an authorization. The floor limit is usually $45-50. A $20 charge, for example, will be accepted without an authorization code so long as the card is not stolen, lost or otherwise bad. Accordingly, the present invention takes advantage of this floor limit.

Many cellular telephone calls may last long enough to exceed the $50 charge. However, users of cellular telephones are accustomed to the problems in the cellular network. Some areas in cells have unclear communications, and many times a telephone call is dropped unintentionally as it passes through a cell. According to the present invention, therefore, microprocessor 202 calculates a current charge at step 318. When that current charge is detected at step 320 to exceed $50 (or some other floor limit) the call is dropped at step 322. The user then needs to call back, but this new call forms a separate transaction which will have its own new floor limit.

In this first embodiment, therefore, all unexpired non-stolen cards are assigned a $50 window. The caller does not wait for any credit card processing delays, but instead this system takes advantage of the floor limit.

A second embodiment of the invention, which uses more conventional techniques, is shown in Figure 3A, with the same steps being indicated by the same reference numbers. Step 300 is the card sliding technique, followed by step 330 which is an internal validation of the number. This internal validation is only a checksum and a determination of card expiration date. The same message displays are produced at steps 306 and 308.

If the credit card is valid, credit card data is captured at step 310.

At step 332, the system automatically dials the telephone number of the host computer. A busy signal at step 334 causes a redial at step 336. Upon making a connection, all of the credit card data is immediately downloaded to the host computer at step 338. A check sum at step 340 causes a resend at step 342 if the information is not correct.

Upon receiving valid information, the host computer provides an indication to the telephone electronics to produce a dial tone at step 344. An indication is also produced at step 346 on the LCD display indicating "dial now". While the user is dialing, however, the host computer produces a message to the processing bank including the credit card number and an amount of an exemplary cellular telephone call, e.g. $50-$100. Simultaneously, the host computer is receiving DTMF tones at step 350 indicative of the telephone number to be dialed. However, no dialing occurs in this embodiment until authorization is received from the processing bank at step 352. If there is no authorization, a message is sent to the LCD display at step 354 indicating "card declined", following by a command for hang-up at step 356. If there is authorization, however, the LCD displays the message "approved" at step 358. At this time, the caller is placed on hold at step 360, and the host computer finds an unused telephone line at step 362. At step 364, the

host computer dials the customer's number, followed by a redial, if busy, at step 366, or a hang-up at step 368 if the line is busy for too long. At step 370 a message is sent indicating that the line is busy. However, if the line is not busy, then the call is connected at step 372.

The host computer stores a certain amount of information for each call in its associated memory 410. At step 374, the host computer reads the time and date and stores the appropriate data. The host computer then becomes inactive, and waits for the call to be detected as complete at step 376. Host computer then reads the current time at step 378 and stores data indicative thereof. At step 380, the host computer calculates call charges, and sends a message to the telephone at step 382 indicating that the current call charges are X. The host computer may then send another message such as Thank you at step 384, followed by a hang up at step 386.

The host computer then again accesses the processing bank at step 388, and requests payment from the card user. The record is stored to an internal processing unit of the host computer at step 390.

A block diagram of the electronics of the host computer is shown in Figure 4. A flowchart of the communication carried out by the computer is shown in Figure 5.

The host computer includes a plurality of line interface cards 400, each of which receives information from a telephone line 402. The line interface card provides certain handshaking with the call to be sure that the incoming call is actually an authorized call.

According to the preferred mode of the present invention, the line interface card answers with a special tone, e.g. 400 hertz, which is received by telephone 100 as a request to send handshaking data. The telephone responds by sending the message that is currently in its message memory. According to the preferred mode of the present invention, the message in this memory is encrypted using the clipper chip (TM). An alternative preferred mode, however, encrypts the message using public key encryption, using a program such as Pretty Good Privacy (TM) available from various sources. Public key encryption has many advantages. First, public key encryption is well-established, and is virtually unbreakable. Public key encryption prevents anyone from reading the confidential information in the message, which includes the credit card number. It also has an additional advantage of uniquely identifying the sender of the information.

Security is very important in this system, since according to at least one aspect, the credit card number on the message has already been verified by the telephone electronics. Also, since the host computer acts on this

message by placing a telephone call to the number listed in the destination, unauthorized access to this computer can allow a user to surreptitiously obtain free telephone calls.

The I.D. number in the message memory 208 uniquely identifies the telephone from which the calls have originated, e.g. it lists the telephone's ESN. Various parts of public key encryption (a description of which is found, for example, in U.S. Patent No. 4,405,829, the disclosure of which is herewith incorporated by reference), also provides information from which the user can be unambiguously identified.

At step 502, the host computer receives the message from the telephone and decrypts it. Step 504 authenticates the message from the encryption and/or from the ESN of the calling telephone. If authentication is unsuccessful, the process is stopped at step 506, although it should be understood that additional operations could be carried out to trace the unauthorized communication. If the communication is determined as authentic in step 504, however, the message is stored in a memory at step 510 and the actual phone number is called at step 512.

As step 514, the system patches the incoming call to the destination phone number. The patching is carried out in two different ways according to two different embodiments of the present invention.

Figure 6 shows the patch carried out according to the centrex embodiment of the present invention. Centrex is a system which uses the local switching office 110 as a PBX. The user communicates via DTMF pulses with the local switching office to control its operation. The patch according to this embodiment includes the steps of controlling the local office to call the destination on a separate line from the incoming line at step 600. At step 602, the call in progress is turned into a three-way call between the incoming line, the host computer, and the destination. The three-way call operation is controlled by the local office. The carrier is monitored at step 604 once the three-way call has been started. Step 606 determines if the carrier is completed, and if so indicates that the current line can be dropped. This also sets the current time in memory 410 as the end time for the call.

At step 610, the call duration is calculated, and the cost is also calculated. The cost may be calculated according to the usual grids of cost, but more preferably, all long distance calls are charged at a flat rate per minute. At step 614, the charge information is transferred to the bank, and also to a non-volatile memory such as a tape drive or a write once read many (WORM) media.

The digital embodiment uses the primary rate interface of the ISDN network to carry out the call

forwarding. This uses a similar flowchart to that described above.

Figure 7 shows a hardware block diagram of the telephone line interface 400 in the host computer. A plurality of lines 702 are input into a line buffer 704 which buffers these lines and provides them to an optical isolation unit 706. Each of the lines is connected to control logic assembly 710 which includes at least an MPU and a switching device. The switching device controls the switching between each input line 712 and a particular output line 714. It should be understood that any input line 712, 713 can be connected to any output line 714, 715. The output lines are also optically isolated and output through line buffer 704.

The system also includes a voltage regulator 720, an RS232 interface 722 through which the MPU is controlled.

Although only a few embodiments have been described in detail above, those having ordinary skill in the art will certainly understand that many modifications are possible in the preferred embodiment without departing from the teachings thereof.

All such modifications are intended to be encompassed within the following claims.

As described herein, the presently preferred embodiment modifies an existing cellular phone by adding an interface assembly thereto to form a credit-card based

cellular telephone. This interface assembly only incrementally increases the size of the cellular phone, but enables additional functions to be carried out, and also enables a credit card or debit card reading operation. While the description given herein describes credit card reading by a magnetic reader, it should be understood that debit cards, ATM cards, holographic image-retaining cards, and other similar readings could be carried out by the reader, which could be magnetic, optical, or any other type of reader. All of these aspects are intended to be included herein.

The modified cellular phone is shown in Figures 1A, 2B and 3B. The original phone on which the preferred embodiment is based is an OKI phone made by OKI Electronics. Any similar telephone could, however, be modified in a similar way. Basic parts of the telephone include the telephone receiver 110, the telephone transmitter 112 and keypad 114 on front surface 200. Antenna 116 transmits the cellular information. The cellular phone operates using power from battery 120 attached to rear surface 202, or from power supplied through a connector 124. In the unmodified telephone, the battery 120 is connected directly to the rear surface 202 of telephone body 100. The modified telephone has a connection from battery 120 to interface assembly 130, which connects to the rear surface 202 of telephone body 100.

The interface assembly 130 also includes a card sliding slot assembly 132 adjacent a first side surface 206, through which a credit card can be slid. The credit card is slid in a direction such that the credit card's information-containing stripe, preferably a magnetic stripe, comes into contact with a card reader head 134. The slot is formed with inside surfaces 136 and 138 between which the card stripe can be slid. A bottom surface 140 delineates the precise location of the card, which places the magnetic stripe into the proper registration contact with the reading head 134.

The surfaces 136 and 138 include tapered distal portions at both top and bottom ends 142 and 144 which increases a distance between the surfaces 136 and 138. These tapered locations allow the card to be more easily positioned into the slot.

The battery is held onto the interface assembly 130 with a clip assembly 150. The battery 120 is the same battery which was used in the original telephone, and the original telephone also includes a clip assembly 152 therein. However, this clip assembly 152 is not used, and instead a duplicate clip assembly 150 holds the battery 120 into place.

The electrical operation of the credit card-operated telephone is somewhat different than the operation of the usual telephone. The usual telephone bills all calls directly to the owner of the telephone.

By simply operating the telephone, the cellular system can determine to whom the call should be billed. The credit card telephone system requires a modification to the basic system to enable billing. In the system described in application No. 08/291,036, the disclosure of which is herewith incorporated by reference, the interface circuit card controls the basic operation of the telephone in a different way. In this modification, the telephone is reprogrammed to call a processing center which processes the credit card information, and then forward the call to the final receiver.

Another system processes credit card information within an interface circuit card, and enables a call to be sent or received only once the credit card information is received. A memory could then be periodically polled. The specific electrical layout and functioning of this circuit card is not relevant for purposes of the present invention, it being sufficient to understand that additional circuitry must be added to that circuitry already present in the cellular telephone.

In all cases, the information on the credit card must meet a predetermined condition (e.g., credit approval) before the cellular call will be enabled.

A connection diagram between the unmodified phone 400, and the interface assembly 130 is shown in Figure 4A. In the unmodified telephone, the battery 120, shown in Figure 5A, connects directly to connectors 410. A

clip 152 holds the top end 500 of battery 120 into place, and maintains the electrical connection therebetween. The bottom end 502 of the battery 120 is received in a groove 412 formed in the phone to connect the other end of the battery 120 into place. The interface assembly 130 is formed of a planar sheet of plastic, connected to the card reader slot 132, shown in more detail in Figures 6A, 7A, 8 and 9.

Figure 6A shows a rear view of the interface assembly 130: the view seen from the battery side of the telephone. A duplicate connector 600 is located so as to protrude from a rear surface 601 of the telephone. Connector 600 includes prongs 602 located in a similar orientation to those of connector 410, and connecting with the connector points 504 on the battery 120. The rear surface 601 also includes the duplicate clip 150, and a slot assembly 412, which hold the respective ends of the battery 120 into place. The rear surface 601 of this interface assembly as shown in Figure 6A is therefore substantially mechanically the same as the rear side 420 of the unmodified phone as shown in Figure 4A. The surface 601 and front surface 603 are substantially parallel to one another but the slot extends above the front surface 603 in a plane perpendicular to the parallel surface.

The interface assembly is also arranged to form the slot 132 with its opening on the front surface shown

in Figure 8. The front surface as shown in Figure 8 also shows the slot and the circuit board assembly 802 with its reader head 134. The circuit board assembly includes a circuit area 804 thereon including both active and passive circuitry and preferably at least one microprocessor programmed to carry out specific functions. The power for the circuitry is received from the connector 600 via the existing battery 120.

Figure 9 shows a cross section of the device along the line 9-9, showing the plastic surfaces forming the elements. The circuit board 802 and reading head 134 are shown integrated in this relatively thin package.

Figure 4A shows the interface assembly 130 as preferably connected by wires 422 to the existing telephone. Locations on the circuit board 802 are wire connected via wires such as 422 to various connectors. These points on the circuit board carry the power from the battery 120 connected to connector 600, to the existing cellular phone circuitry. The magnetic reader 134 is also connected via connections 424 to appropriate locations 426 on the existing circuit board.

The connection between the devices is established by first preparing a wire connection such as 422, and then screwing the interface assembly 130 into the body of the existing phone, from the bottom surface 602 of the interface assembly, into the rear face 420 of the existing cellular telephone. This mounts the interface

board into precise registration with the body of the cellular telephone.

One advantage of the present system is the small width increase which it adds to the cellular telephone. A certain amount of width is necessary for the card reader to operate properly. However, according to the present invention, the card reader is formed bordering a side surface of the existing cellular telephone. See, for example, Figure 3B which shows that the existing body of the cellular phone 100 accommodates a majority of the width of the card reader slot 132. The interface assembly thickness is limited only by the thickness of the circuit board 802 and the necessary thickness of the plastic 700 forming the interface assembly. This can be done with as little as 3/8 of an inch addition to the thickness of the overall cellular telephone.

One important feature of the present invention is its cloning of the existing battery clips and contact to enable the existing cellular phone parts to be reused. The existing cellular phone battery is attached, without any modification to the battery, onto the interface assembly. Since the same electrical configurations and mechanical layouts are used, this provides a very convenient mechanism of re-using these parts in a modified cellular telephone.

Detailed drawings of the connectors 410 and 600 are shown in Figures 10-12. Figure 10 shows a top view

of this connector, with Figures 11 and 12 showing cross sections along the lines 11-11 and 12-12 respectively. These connectors include contacts 602 which protrude above a top surface 1100 of the connector assembly. The contacts also include solder-down locations such as 1000, enabling them to be soldered to a circuit board. By using the same connector on the interface circuit board which is already provided on the telephone, the battery fits thereon without modification. Clips 150 and slots 412 also allow the battery to mechanically fit on the interface board. Also importantly, since the interface assembly allows the credit card slide slot to be located adjacent the existing cellular phone, it modifies that existing cellular phone with only a minimal amount of thickness changes.

Although only a few embodiments have been described in detail above, those having ordinary skill in the art will certainly understand that many modifications are possible in the preferred embodiment without departing from the teachings thereof.

All such modifications are intended to be encompassed within the following claims.

What is claimed is:

1. A method of establishing a cellular telephone connection between a calling cellular telephone and a destination remote premises, comprising:

entering a destination telephone number representing a telephone number of the destination remote premises into the calling cellular telephone;

controlling the calling cellular telephone to dial a central number, different than said destination telephone number, and to establish a communications connection with said central number;

transferring said destination telephone number to a receiver at a premises of said central number; and

establishing a telephone connection between the premises of said central number and said destination telephone number and establishing a connection between said calling cellular telephone and said destination number via said premises of said central number.

2. A method as in claim 1 wherein said premises forms a three-way call including the cellular telephone and the destination telephone number.

3. A method as in claim 1 wherein said premises controls a digital switching office to directly connect said cellular telephone to said destination telephone.

4. A method as in claim 1 comprising the further step of entering credit card billing information into said cellular telephone, and transferring said credit card billing information to said central telephone premises.

5. A method as in claim 1 comprising the further step of encrypting information transmitted from the cellular telephone to the receiver.

6. A method as in claim 4 wherein said credit card billing information is compared against a database of unacceptable numbers stored in said cellular telephone.

7. A method of processing and completing a credit card based cellular telephone communication, comprising the steps of:

obtaining billing information and a destination telephone number from a caller at a cellular telephone station which is initiating a call to a destination telephone number;

storing said billing information and said destination telephone number in a memory of the cellular telephone station;

calling, from said cellular telephone station, a central processing telephone number, different than said

destination telephone number and establishing a telephone connection between said cellular telephone station and a central processing station addressed by said central processing telephone number;

communicating said billing information and said destination telephone number from said cellular telephone memory to said central processing station;

establishing a telephone call to said destination telephone number from said central processing telephone number, and connecting said cellular telephone station to said destination telephone number via said central processing telephone number; and

controlling billing of charges for said telephone call from said central processing station, including monitoring a duration of said telephone call from said central processing station.

8. A method as in claim 7 wherein said controlling billing comprises periodically polling a computer which controls long distance billing to obtain long distance billing information.

9. A method as in claim 8 comprising the further steps of monitoring a length of said telephone call, determining when a total charge for the telephone call exceeds a prestored limit; and terminating the telephone call when said total charge exceeds said prestored limit.

10. A method as in claim 7 wherein said connecting step uses digital telephone system messages and data and calls such as GSM 900, TDMA, SMR or other similar digital technologies.

11. A cellular telephone communication and billing system, comprising:

a cellular telephone, comprising;

a keyboard through which a destination telephone number is entered to initiate a call to a destination;

a credit information inputting device, through which credit information is input as a source of payment for the call to the destination;

a memory, storing the entered credit information and the destination telephone number from a caller;

a dialer, programmed to dial only a central processing telephone number, different than said destination telephone number when a call is commanded, said dialer dialing no number other than said central processing number when the call is commanded, said central processing number being a telephone number of a processing center where billing information is processed;

a data sending element, transferring said billing information and said destination telephone number from said memory to [a location of] said central processing telephone number when said call is connected; and

a remote computer, located at said processing center, receiving said billing information and destination telephone number, and completing a call to said destination telephone number, and monitoring and controlling billing activities.

12. A cellular telephone and billing system, comprising:

a cellular telephone station, including a cellular communication processor, a credit card input device operating to receive credit card information, a destination telephone number input device through which a destination telephone number is entered, a cellular telephone number dialer, and a processor, said processor controlling said cellular telephone number dialer to dial a prestored telephone number, different than said destination telephone number, whenever a call is initiated, and controlling said dialer so that only said prestored telephone number, and not said destination number, can be dialed when said call is initiated and credit card information is entered;

a mobile telephone switching office, communicating with said cellular telephone station, and receiving information therefrom including said prestored telephone number and communications information;

a local central office, connected to said mobile telephone switching office by land-line wires, said local

central office switching a call from said mobile telephone switching office;

a remote central office, connected to said local central office via a telephone trunk, said remote central office being one which services said prestored telephone number;

a processing device, connected to receive communications via said prestored telephone number, said remote central office connecting said call to said processing device, said processing device receiving said credit card information and verifying validity of said credit card information, and said processing device receiving said destination telephone number entered on said destination telephone number input device and, if said credit card information is valid, completing a call to said destination telephone number, and connecting said call to said destination telephone number.

13. A system as in claim 12, wherein said processing device completes the call to the destination by forming a three-way telephone call between said cellular telephone station, said processing device and said destination.

14. A system as in claim 12, wherein said processing device completes said call by controlling said

remote central office to directly connect said cellular telephone station to said destination.

15. A system as in claim 12, wherein said prestored telephone number is a toll-free telephone number.

16. A system as in claim 12 wherein said cellular telephone station includes an encryption processor which operates to encrypt said credit card information and to send encrypted credit card information to a connection with said prestored telephone number.

17. A method of controlling a credit card operation of billing for credit card operated cellular telephone calls, comprising:

entering a credit card into a credit card reader on a cellular telephone to enter credit card information thereinto;

entering a destination telephone number into the cellular telephone;

determining when entry of said destination telephone number has been completed;

upon determining that entry of said destination telephone number is completed, dialing a telephone number of a processor, said telephone number of said processor being different than said destination telephone number;

transmitting a message including at least said credit card information and the destination telephone number to said processor;

determining, using said processor, whether said credit card information is valid;

if said determining step determines that said credit card is valid, using said processor to establish a telephone connection with said destination telephone number via said processor; and

using said processor to monitor and control billing of said cellular telephone.

18. A method as in claim 17, further comprising determining, in said processor, if an incoming call is an authorized call.

19. A method as in claim 18, wherein said determining comprises decrypting an incoming message, and determining if the decrypted message indicates an authorized message.

20. A method as in claim 18, wherein said telephone connection is established by forming a three way call between the cellular telephone, said processor and said destination.

21. A method as in claim 18, wherein said telephone connection is established by said processor controlling a telephone central office to form a connection between the cellular telephone and said destination.

22. A method as in claim 17 wherein said determining includes counting digits of the destination telephone number and determining, from said counting, whether the telephone number is complete, said determining including determining whether an entered telephone number is local or long distance, determining a necessary number of digits to complete said telephone call, and counting said necessary number of digits.

23. A method as in claim 17 further comprising determining unauthorized charge;

determining a current charge; and

dropping the call when the current charge exceeds the authorized charge.

24. A method of controlling a credit card-based cellular telephone, comprising:

entering a credit card into a credit card reader on a cellular telephone to enter credit card information thereinto;

entering a destination telephone number into the cellular telephone;

determining when entry of said destination telephone number has been completed;

controlling said cellular telephone so that it can only call a telephone number of a processor, said telephone number of said processor being different than said destination telephone number;

transmitting a message including at least said credit card information and the destination telephone number to said processor;

determining, using said processor, whether said credit card information is valid;

if said determining step determines that said credit card is valid, using said processor to establish a telephone connection with said destination telephone number via said processor; and

using said processor to monitor billing.

25. A cellular pay telephone assembly comprising:

a cellular telephone body, including a front surface, a second surface including an electrical contact set, and first and second side surfaces, each said side surface extending between said front surface and said second surface, said front surface including at least a keypad, said telephone also including a receiver, a transmitter and an antenna;

a slot assembly including first and second substantially flat side surfaces which are substantially parallel to one another and which define a reading area therebetween, and said slot assembly also including and having its inside area bounded by a bottom surface which is a substantially flat surface extending between first portions of respective first and second side surfaces of said slot assembly, said slot assembly located adjacent and bordering said first side of said cellular telephone body;

a reader assembly, extending into said inside area of said slot assembly, said reader assembly having a reading surface positioned to read information from an element which is passed through said inside area of said slot assembly;

an electronic assembly, including electronic circuitry thereon which drives the reader assembly and receives and interprets information therefrom; and

a battery, electrically in contact with said electrical contact on said second surface, said battery providing electrical power for said electronic circuitry.

26. A telephone assembly as in claim 25 when said first and second side surfaces of said slot assembly include first parallel portions, and second and third non-parallel portions at distal ends thereof, said second and third non-parallel portions include a tapered

location at which a distance between said first and second surfaces is increased.

27. A telephone assembly as in claim 25 further comprising an interface assembly, including a clip and slot assembly coupled to said second surface of said body of said cellular telephone, said clip and slot assembly mating with corresponding structures on the battery to hold the battery in place and including an electrical contact set which is electrically coupled to said electrical contact on said second surface.

28. A telephone assembly as in claim 27 wherein said electrical contact set on said interface assemble is of a shape and arrangement to mate with said corresponding contacts on said battery.

29. A telephone assembly as in claim 25 further comprising an interface assembly, connected to said slot assembly, said interface assembly coupled to said second surface of said body of said cellular telephone and including a planar plastic sheet connected to said slot assembly, said planar plastic sheet defining two parallel surfaces, a first of said parallel surfaces having a clip and slot assembly, said clip and slot assembly mating with corresponding structures on the battery to hold the battery in place and having an electrical contact set

which is electrically coupled to said electrical contact on said second surface, and receiving the battery connected thereto, and a second of said parallel surfaces connected against said second surface of said cellular telephone body, said slot assembly extending above said second parallel surface in a plane perpendicular to said first and second parallel surfaces, in a direction away from said first parallel surface and located bordering said telephone body.

30. A pay cellular telephone, comprising:

a cellular telephone including a body having first and second sides, a front surface and a second surface including an electrical contact set, said front surface including at least a keypad thereon, said telephone also including a receiver, a transmitter and an antenna, and said telephone including electrical circuitry therein which places a cellular telephone call to a desired telephone number responsive to information entry on said keypad;

a slot assembly including first and second side surfaces which are substantially parallel to one another, and are substantially flat, and including a bottom surface which is a substantially flat surface and which extends between first portions of respective said first and second side surfaces of said slot assembly, a reading area defined between said first and second side surfaces

and said bottom surface, said slot assembly located adjacent said first side of said cellular telephone body;

a reader assembly, located extending into said reading area of said slot assembly, positioned to read information from an information-containing element which is passed between said first and second surfaces of said slot assembly;

reader electronic circuitry associated with said reader assembly, driving said reader assembly to read said information, and to translate said information into a form which can be interpreted by said reader electronic circuitry, said reader electronic circuitry including enabling circuitry structure, which selectively enables said telephone electronic circuitry only when said information meets a predetermined condition; and

a battery connected to said second surface providing power for said telephone electrical circuitry and for said reader electronic circuitry.

31. A method of retrofitting a cellular telephone to accept payment information, comprising the steps of:

removing a battery from an existing cellular telephone;

providing an interface assembly, said interface assembly including holding elements which mate with existing holding structures on the battery, and including first connectors which connect to existing battery

connectors on the cellular telephone, and second connectors which connect to electrical connections on the battery without modification to the battery, and which includes a slot assembly, said slot assembly including first and second substantially flat side surfaces which are substantially parallel to one another and which define a reading area therebetween, and said slot assembly including a bottom surface which is a substantially flat surface extending between first portions of respective first and second side surfaces of said slot assembly, said slot assembly located adjacent one of said sides of said cellular telephone body; a reader assembly, extending into said reading area of said side surfaces of said slot assembly, said reader assembly having a reading surface positioned to read information from an element which is passed through said reading area of said slot assembly; and an electronic assembly, including electronic circuitry thereon which drives the reader assembly and receives and interprets information therefrom;

attaching said interface assembly to said cellular telephone with the second surface thereof facing outward; and

connecting said battery to said second surface to make electrical contact therewith and to operate said telephone and said circuitry based on power therefrom.

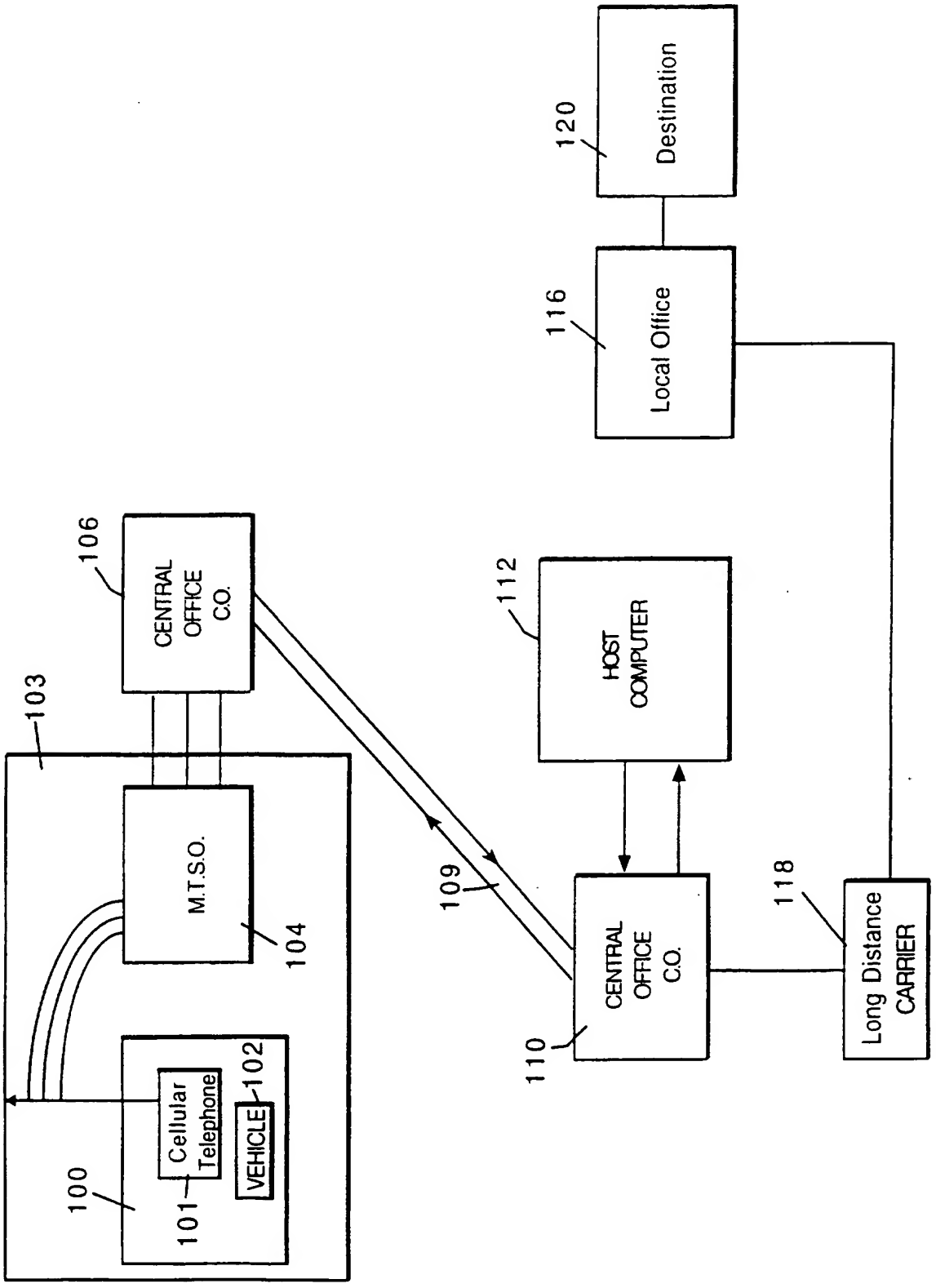

FIG. 1

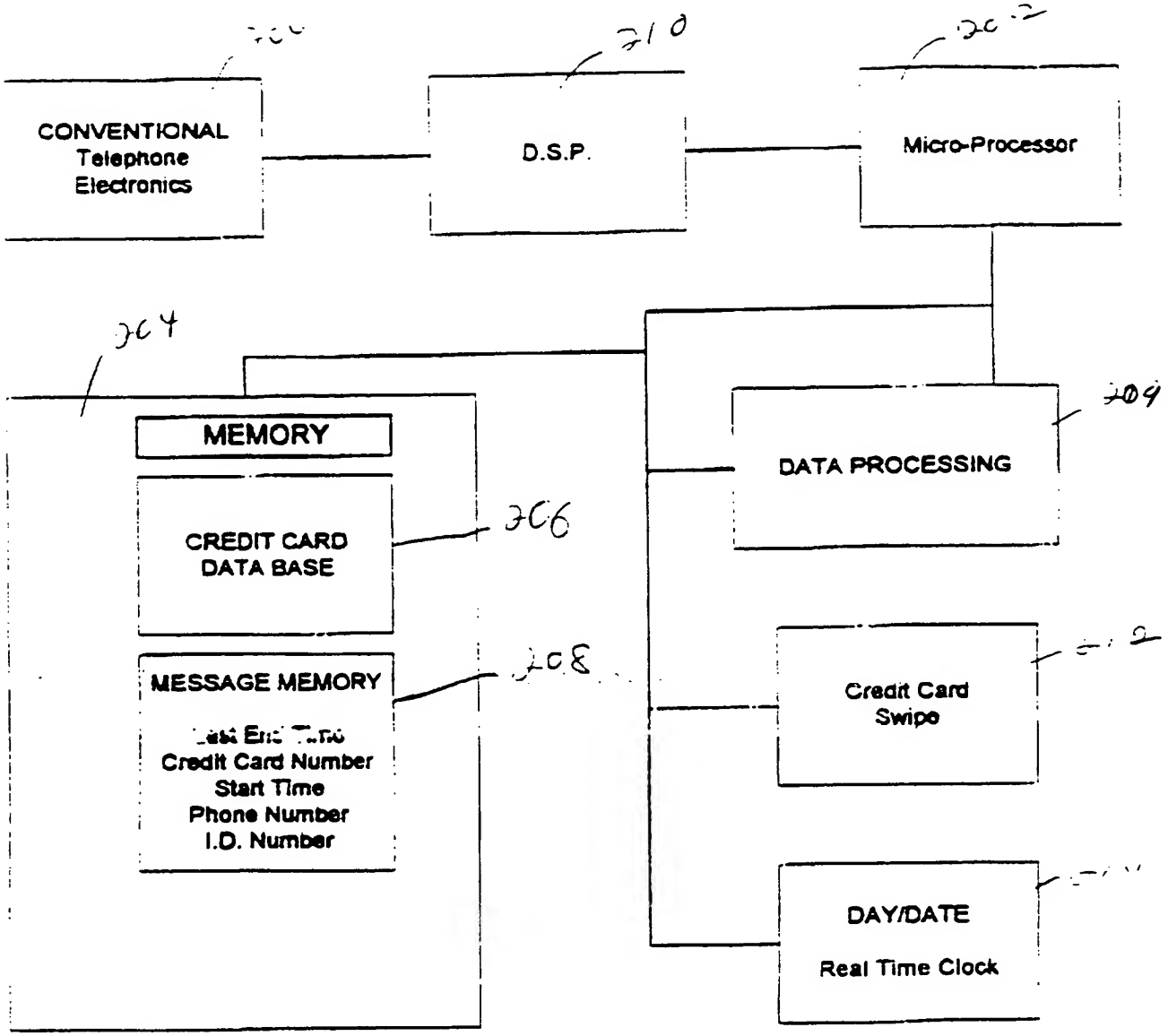
CONVENTIONAL
Telephone
Electronics
D.S.P.
Micro-Processor
MEMORY
CREDIT CARD
DATA BASE
MESSAGE MEMORY
Credit Card Number
Start Time
Phone Number
I.D. Number
DATA PROCESSING
Credit Card
Swipe
DAY/DATE
Real Time Clock

FIG 2

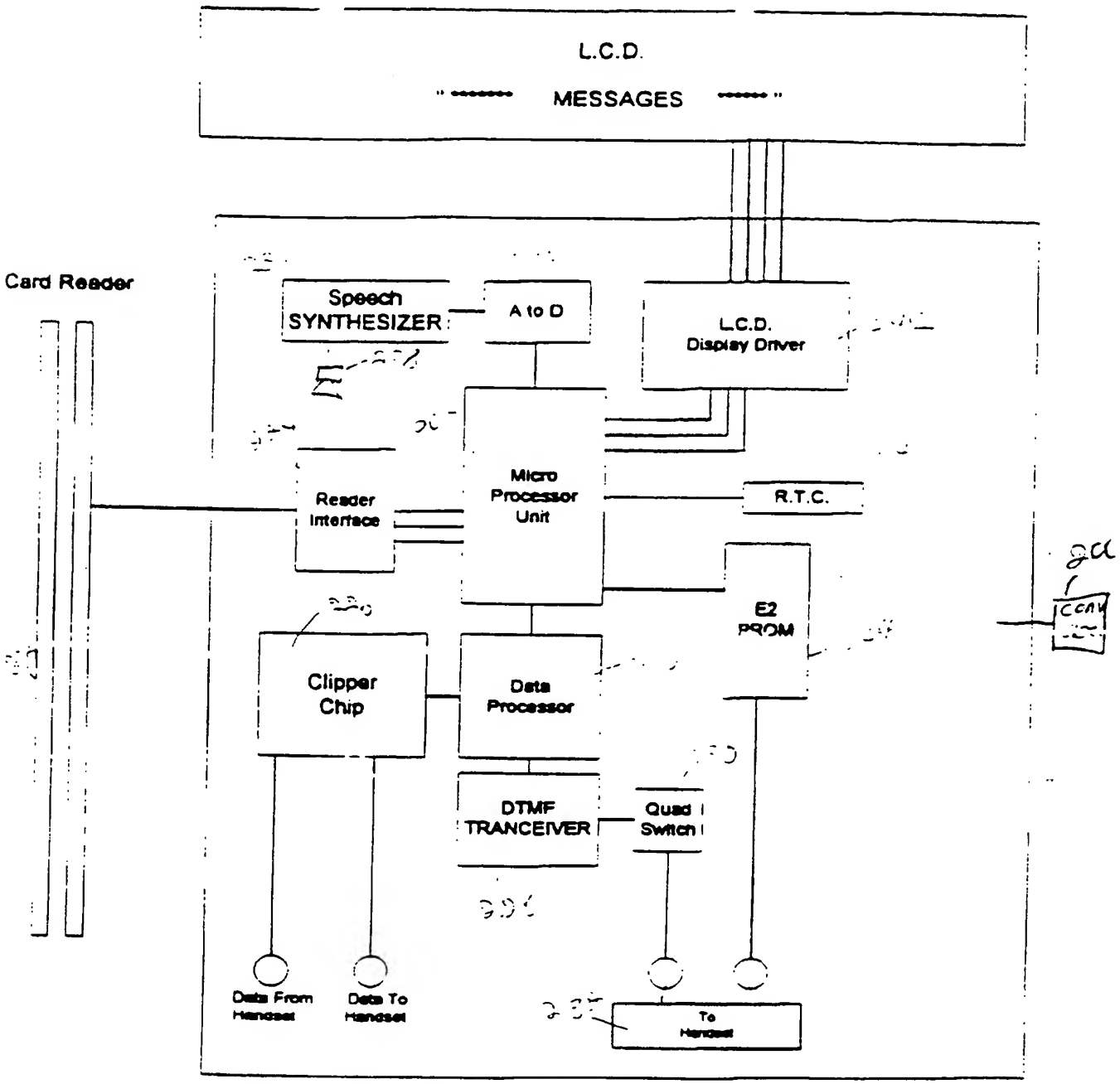
L.C.D.
MESSAGES
Card Reader
Speech SYNTHESIZER
A to D
L.C.D. Display Driver
Reader Interface
Micro Processor Unit
R.T.C.
E2 PROM
Clipper Chip
Data Processor
DTMF TRANCEIVER
Quad Switch
Data From Handset
Data To Handset
To Handset
Cellular Telephone Interface Module

FIG. 2A

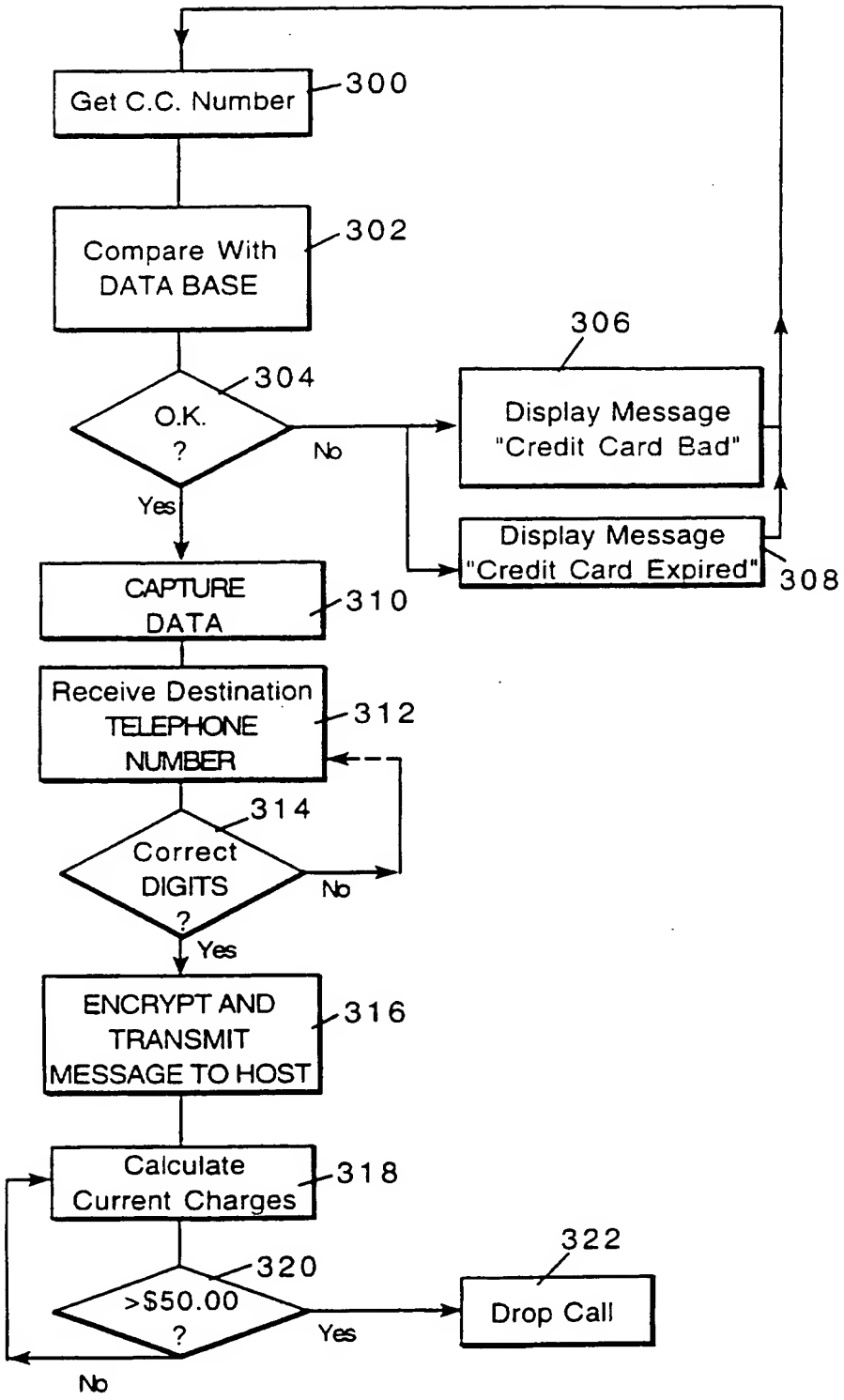

FIG. 3

RECTIFIED SHEET (RULE 91)

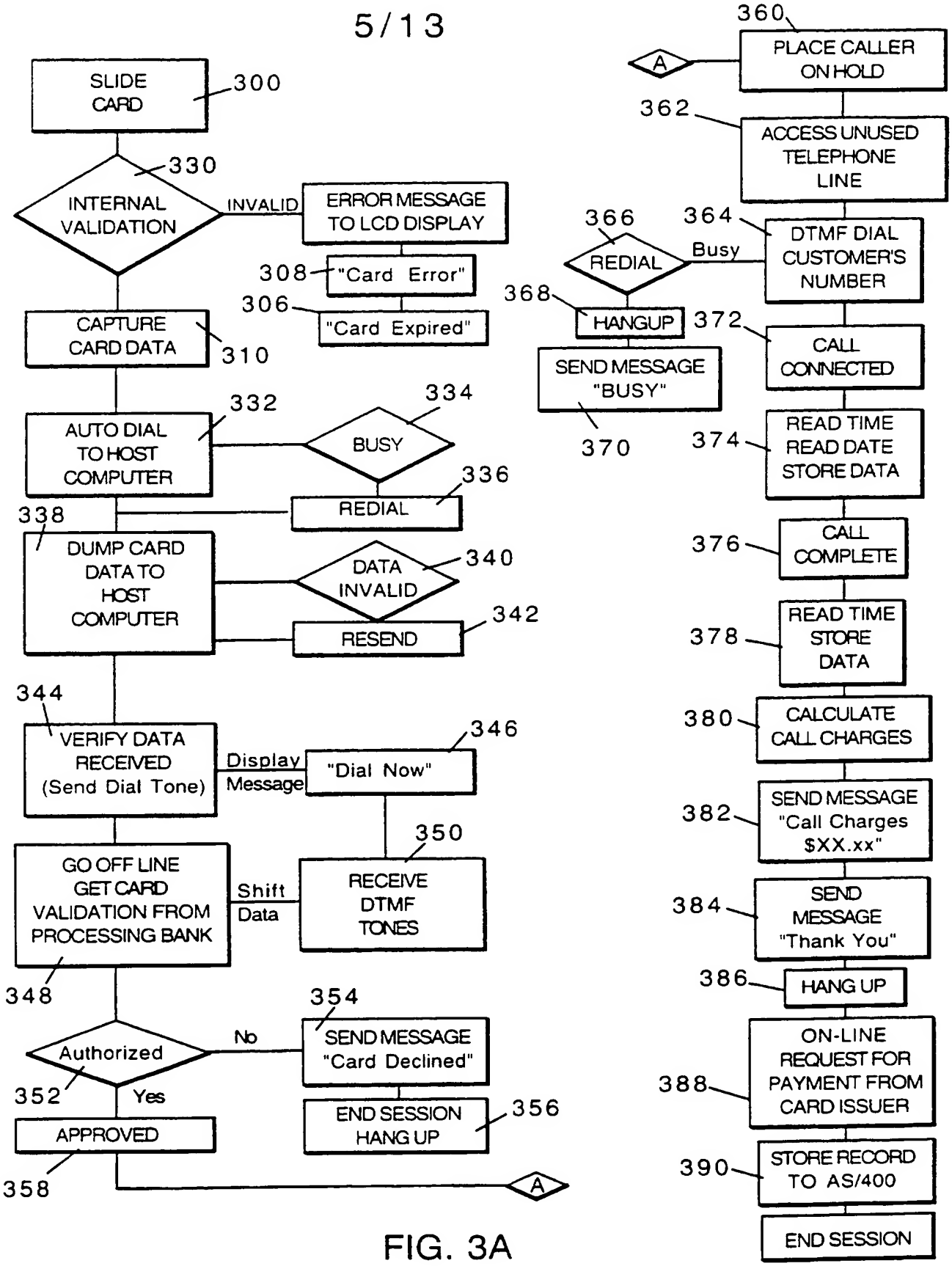

FIG. 3A

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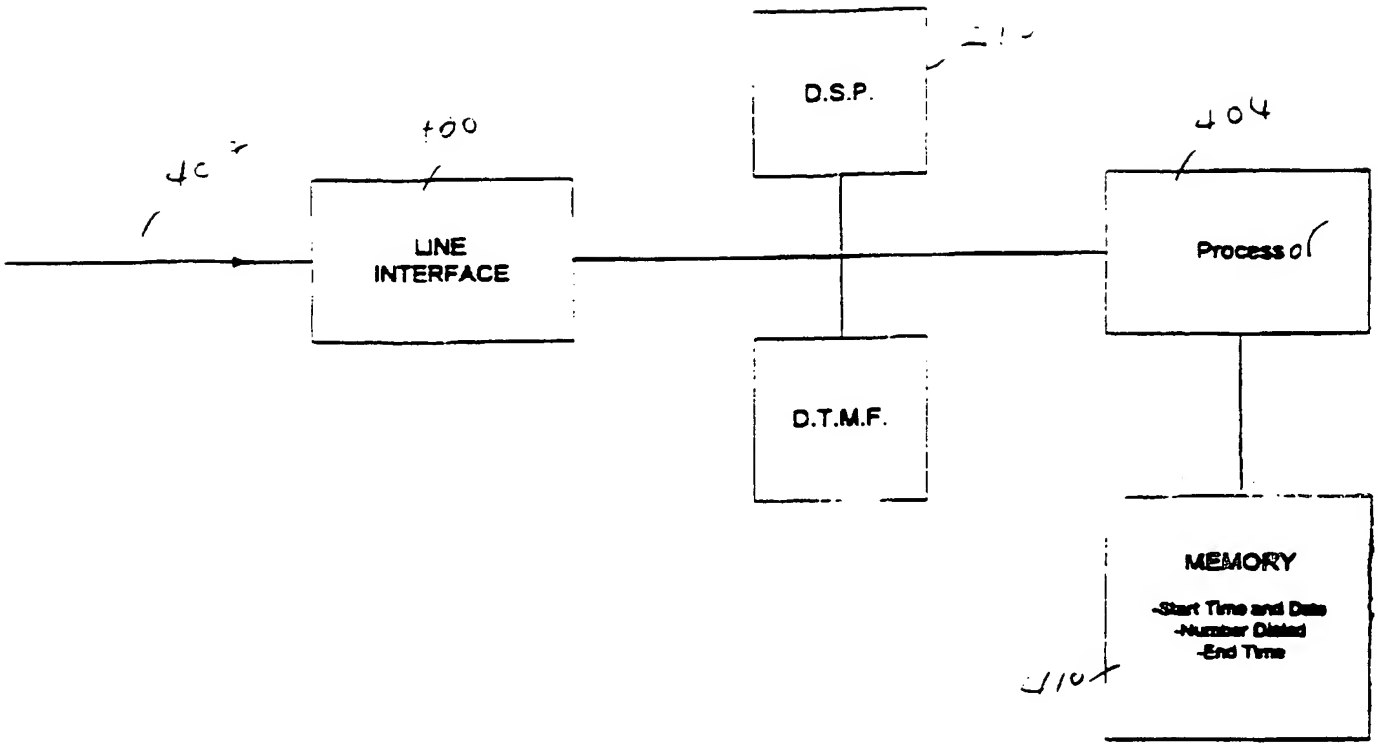
D.S.P.
LINE INTERFACE
Processor
D.T.M.F.
MEMORY
-Start Time and Date
-Number Dialed
-End Time

FIG 4

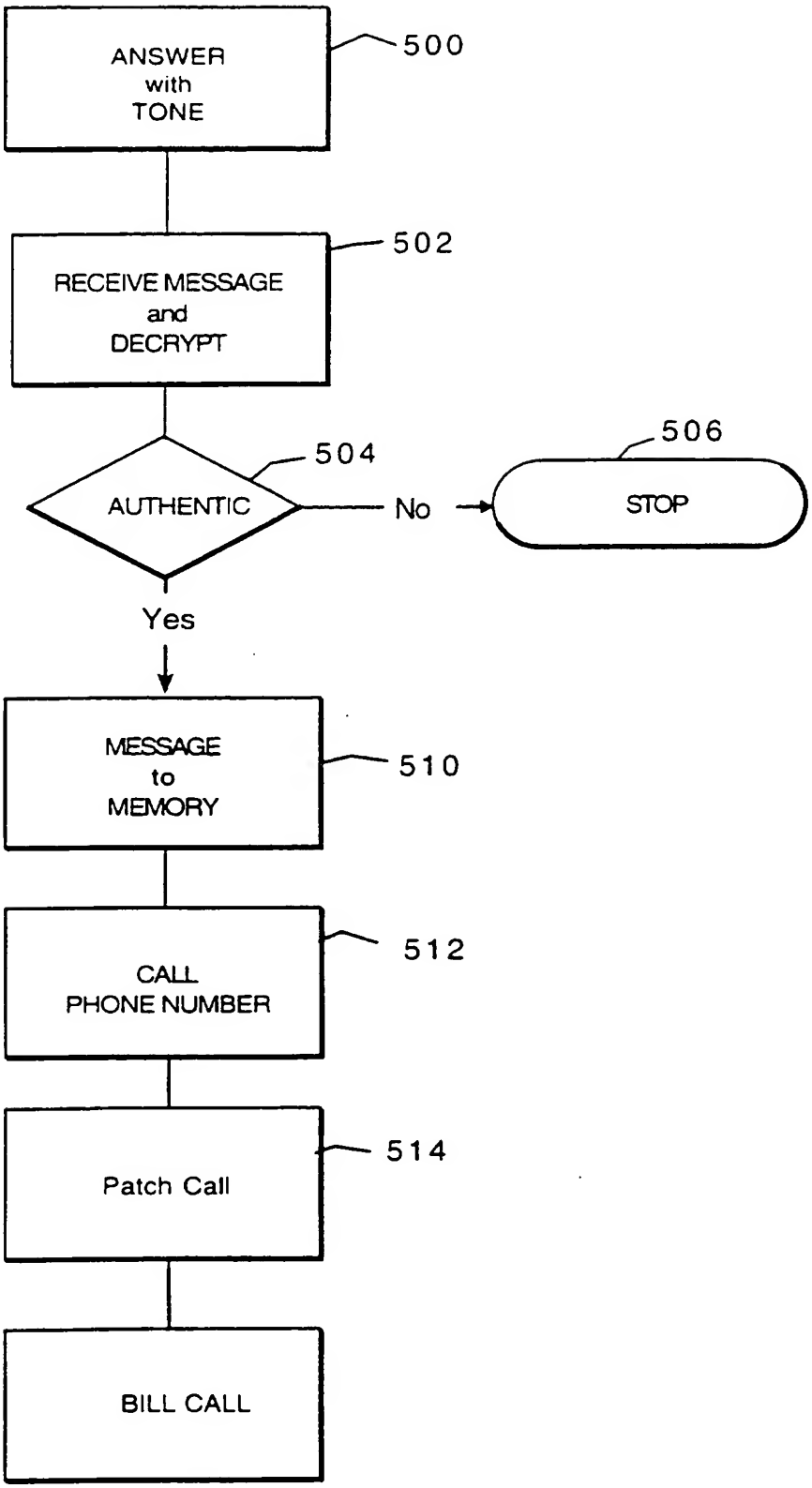

FIG. 5

RECTIFIED SHEET (RULE 91)

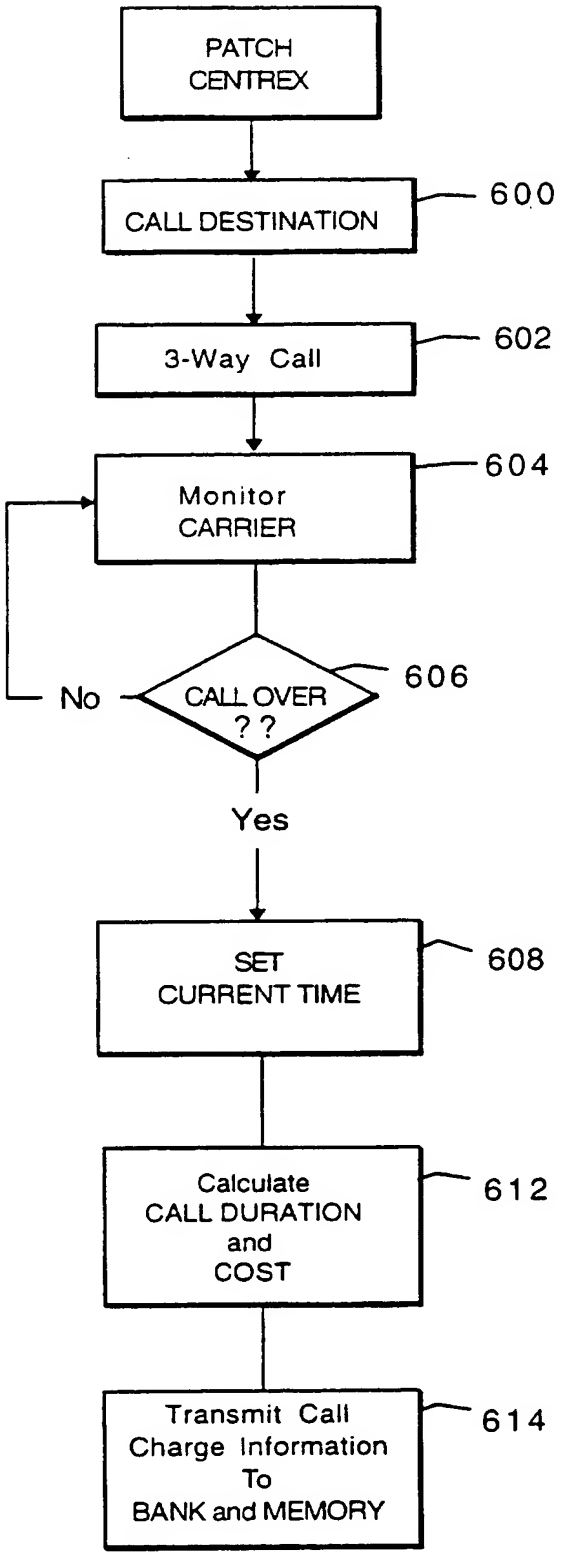

FIG. 6

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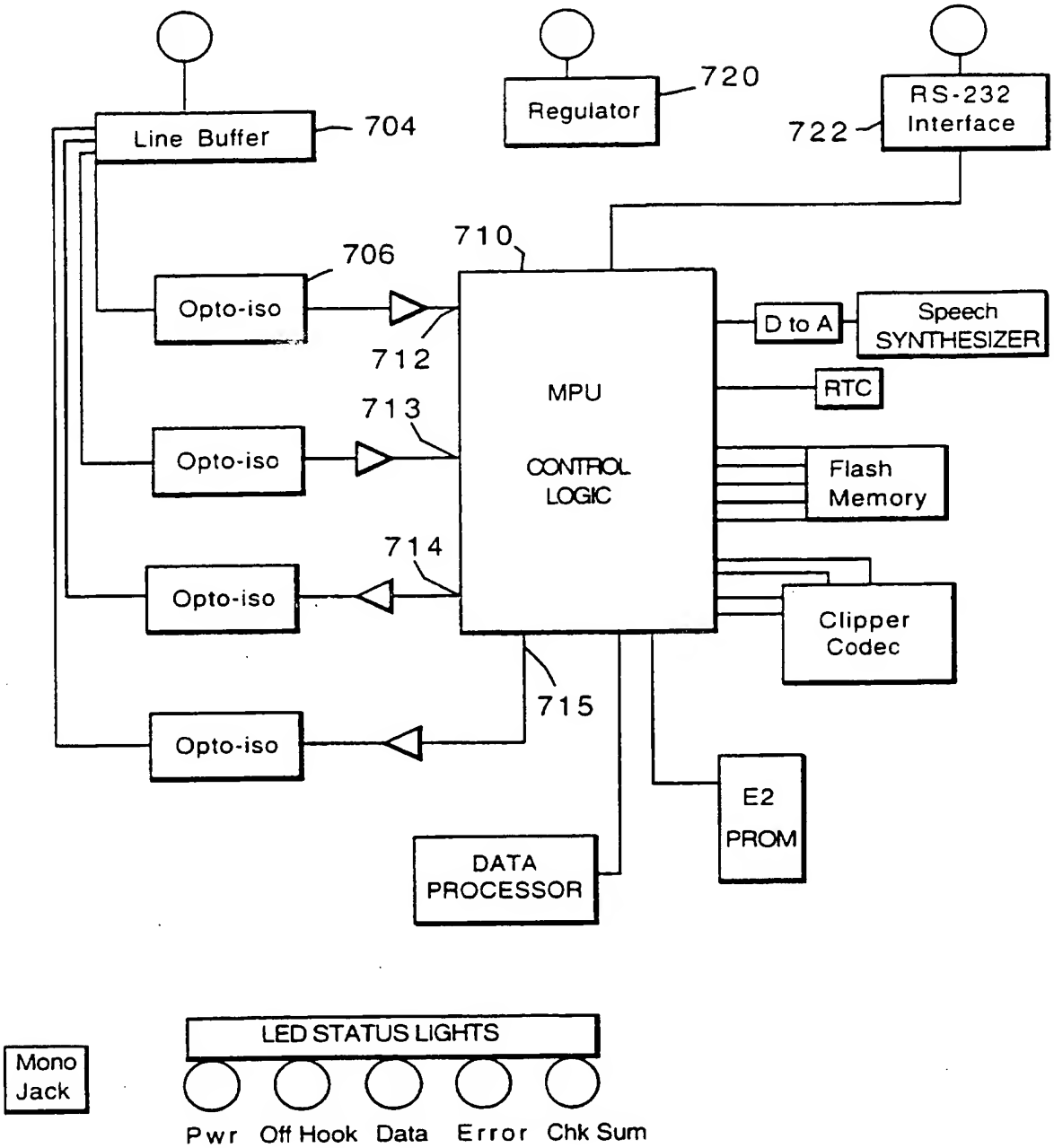
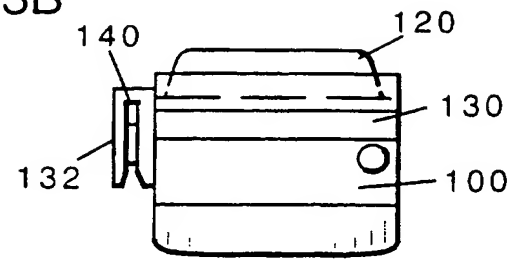


FIG. 7

RECTIFIED SHEET (RULE 91)

FIG. 3B



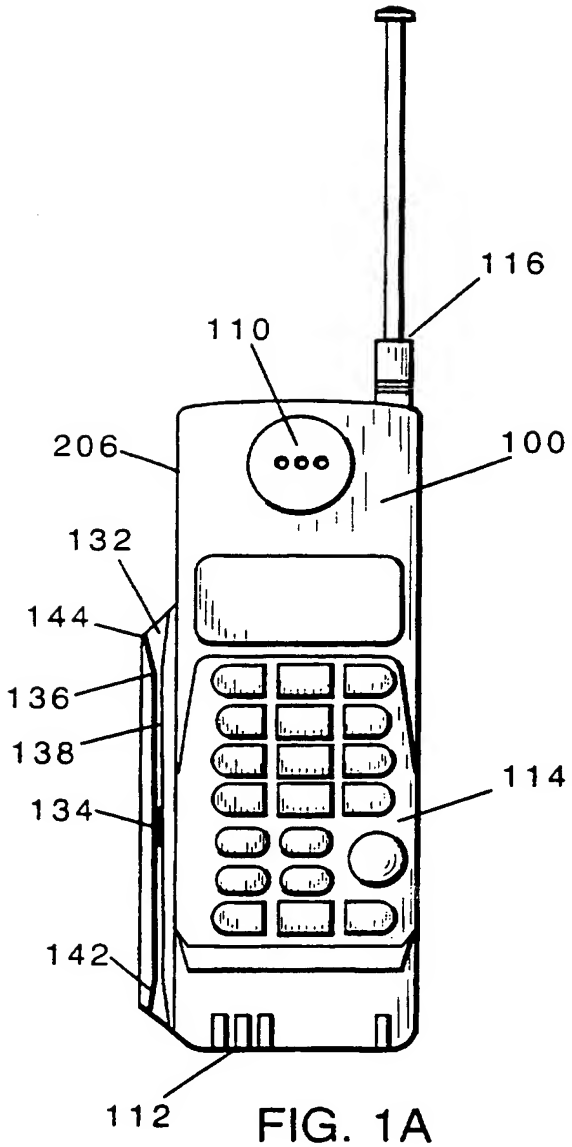


FIG. 1A

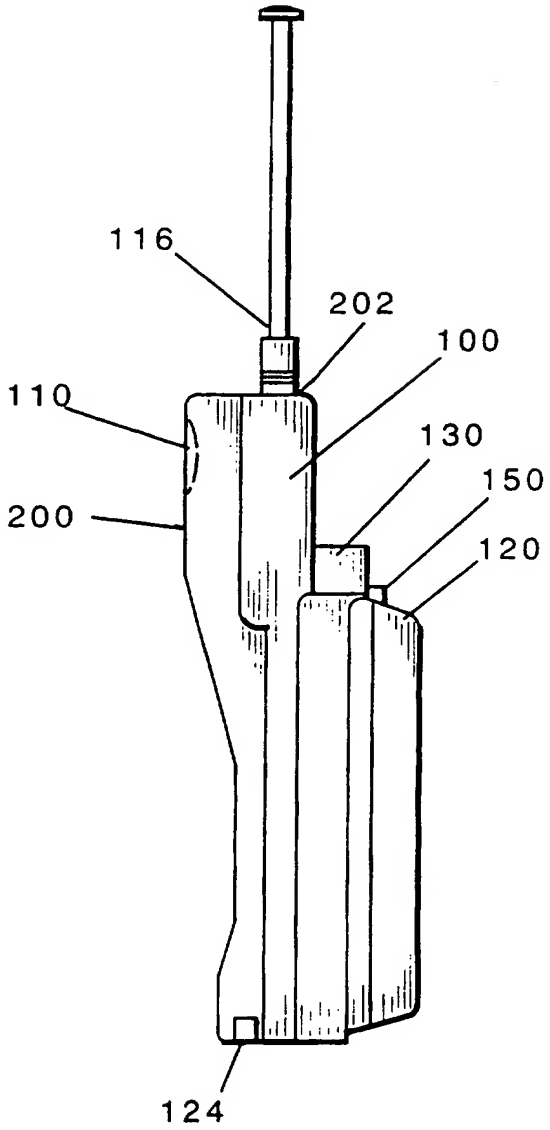


FIG. 2B

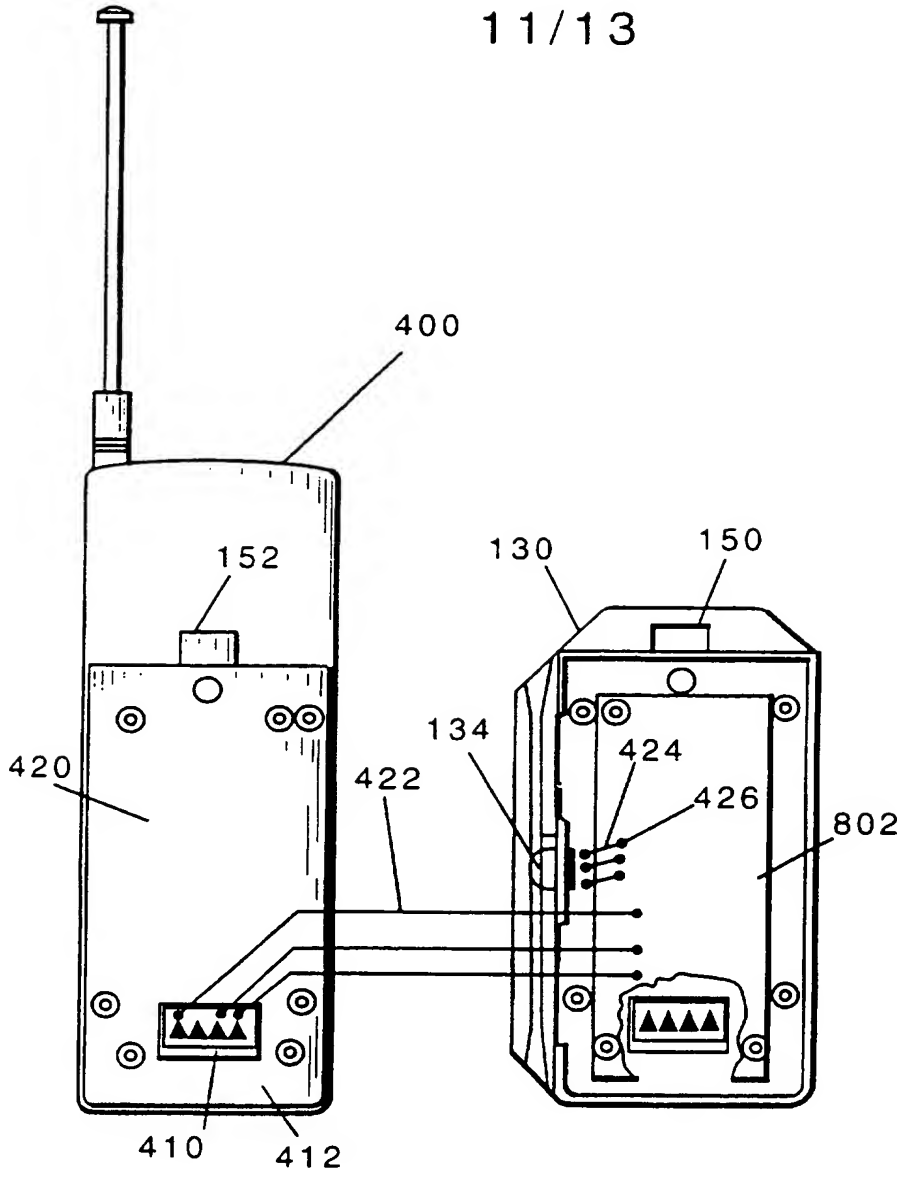


FIG. 4A

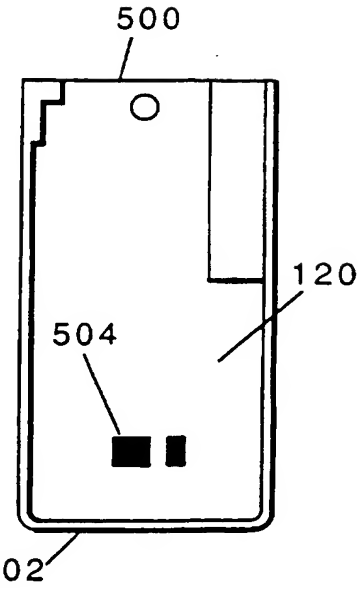


FIG. 5A

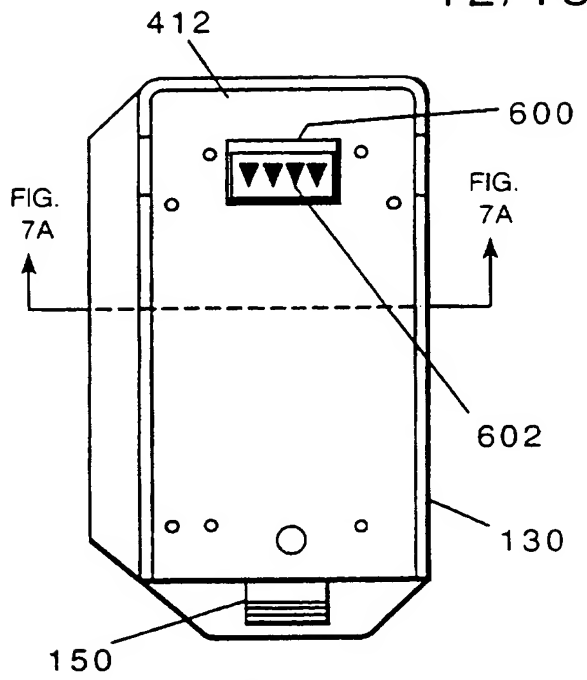


FIG. 6A

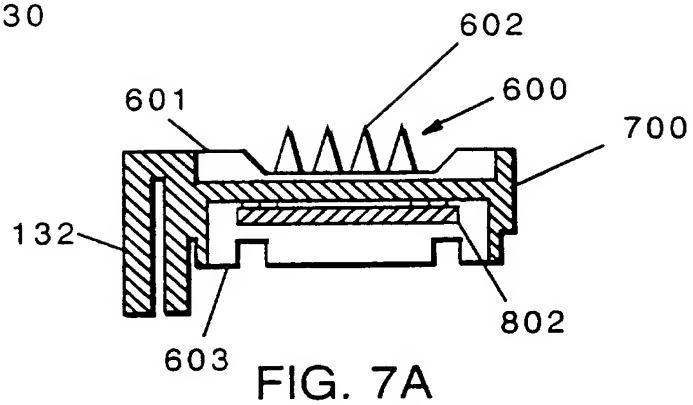
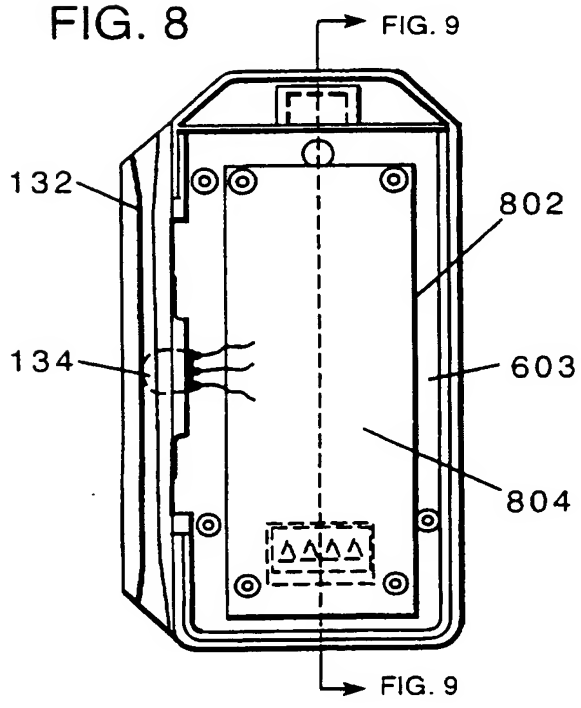


FIG. 7A

FIG. 8



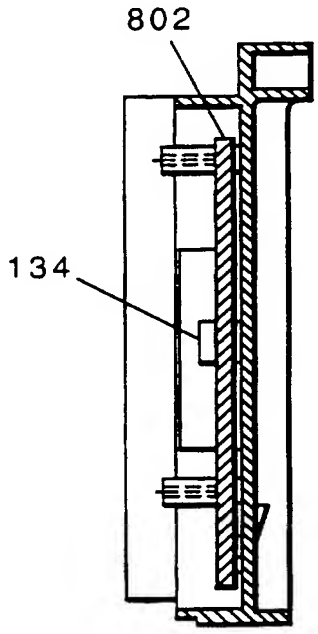


FIG. 9

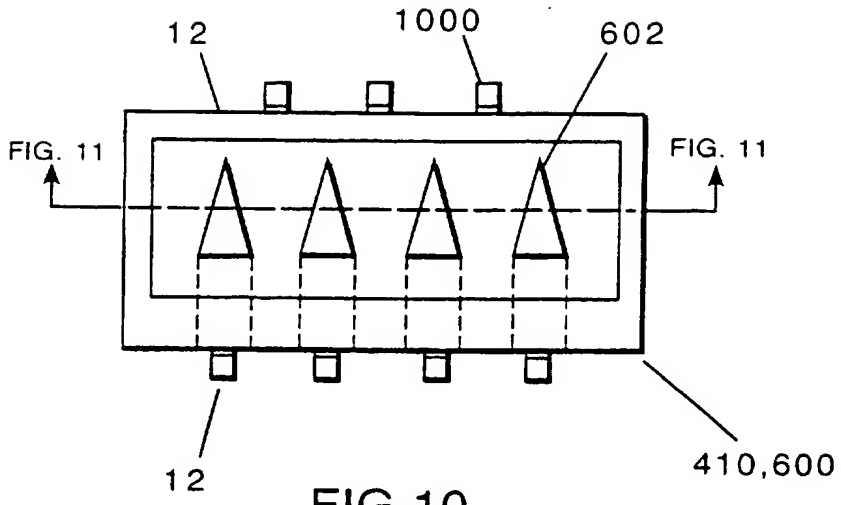


FIG.10

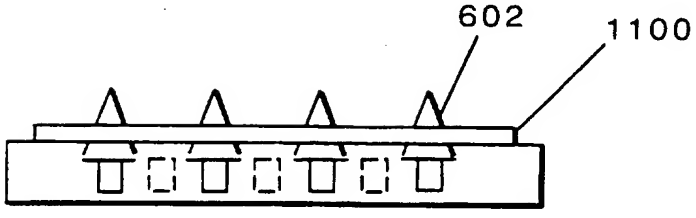


FIG.11

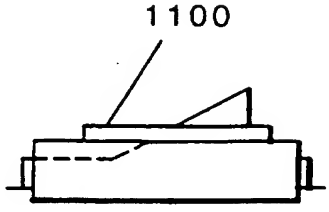


FIG.12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/10361

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04Q 7/22
US CL :379/59

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/59, 58.63,91,111,112,114,121,144,145,357,430,447,450; 455/33.1,89,90; 235/380,381

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,777,646 (HARRIS) 11 October 1988, see the entire document.	1-8, 10-21, 24
Y	US, A, 5,109,401 (HATTORI ET AL.) 28 April 1992, see col. 1, line 43 to col. 2, line 4.	9,23
Y	US, A, 4,737,975 (SHAFER) 12 April 1988, see cols. 10 and 11.	22
Y	US, A, 4,860,336 (D'AVELLO ET AL.) 22 August 1989, see figure 5.	25, 30
Y	US, A, 5,208,446 (MARTINEZ) 04 May 1993, see entire document.	25, 30
Y,P	US, A, 5,408,513 (BUSCH, JR. ET AL.) 18 April 1995, see figure 2.	26

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 OCTOBER 1995	24 OCT 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer George J. Oehling Telephone No. (703) 305-4835

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/10361

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, A, 63-224422 (YAMAUCHI) 19 September 1988, see figure 4.	27, 28, 31

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